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**Understanding the role of HIV testing and counselling
services in HIV prevention in rural Tanzania**

CAOIMHE CAWLEY

**Thesis submitted in accordance with the requirements for the
degree of**

**Doctor of Philosophy
of the
University of London**

NOVEMBER 2015

Department of Population Health

Faculty of Epidemiology and Population Health

LONDON SCHOOL OF HYGIENE & TROPICAL MEDICINE

Funded by the Economic and Social Research Council

Declaration

I, Caoimhe Cawley, confirm that the work presented in this thesis is my own. Where information has been derived from other sources, I confirm that this has been indicated in the thesis.

A handwritten signature in blue ink, appearing to read 'C. Cawley', is written on a light blue grid background.

6th November 2015

Abstract

This thesis aims to describe the uptake and coverage of HIV testing and counselling (HTC) services in a community cohort study in rural Tanzania between 2003 and 2010, and to investigate the impact of HTC on changes in sexual risk behaviour and HIV incidence.

Paper A uses data from three HTC services (community outreach HTC (CO-HTC), walk-in HTC (WI-HTC) and antenatal HTC) linked to the community cohort data to compare the characteristics of services users, and found that while WI-HTC was most likely attract HIV-positive individuals, the overall proportion of infected persons diagnosed was greatest at CO-HTC.

Rates of repeat testing are important to understand given potential HIV treatment as prevention approaches. Paper B found that small proportions of cohort participants repeat tested between 2003 and 2010, although this improved over time.

Paper C presents a quantitative analysis of the impact of CO-HTC on changes in sexual behaviour and HIV incidence, and found moderate associations between HTC use and reductions in some risk behaviours among HIV-negative participants, but no impacts among HIV-positive individuals or reductions in HIV incidence, possibly as a result of small sample sizes and a declining background incidence in the study area.

Paper D presents findings from a qualitative study exploring the effectiveness of HIV prevention counselling messages, which showed that relationship dynamics constrained the extent to which HIV-negative women felt able to control their HIV-related risk, and imbalanced client-counsellor interactions limited communication during counselling sessions.

Overall, the findings from the thesis reveal that provision of different HTC models increased the uptake of services, but the proportions of individuals repeat testing were low and there was limited evidence for an impact of HTC on sexual risk reduction. Future research should explore the effectiveness of different HTC modalities in encouraging repeat testing among high risk HIV-negative individuals, influencing sexual behaviour change and linking HIV-positive people to care and treatment.

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List of acronyms

AIDS	Acquired Immune Deficiency Syndrome
ALPHA	Analysing Longitudinal Population-based HIV/AIDS data on Africa
ANC	Antenatal Clinic
ANC-HTC	Antenatal Clinic HIV Testing and Counselling
ART	Antiretroviral Therapy
CD4	Cluster of Differentiation 4 positive T cells
CI	Confidence Interval
CO-HTC	Community Outreach HIV Testing and Counselling
CTC	Care and Treatment Centre
DSS	Demographic Surveillance System
ELISA	Enzyme-Linked Immunosorbent Assay
HIV	Human Immunodeficiency Virus
HTC	HIV Testing and Counselling
ID	Identification (number)
IDI	In-depth Interview
IT	Information Technology
LSHTM	London School of Hygiene and Tropical Medicine
MRCC	Medical Research Coordinating Committee
NACP	National AIDS Control Programme
NIMR	National Institute for Medical Research
OR	Odds ratio (aOR adjusted odds ratio)
PITC	Provider Initiated Testing and Counselling
PLA	Participatory Learning and Action

PMTCT	Prevention of Mother-to-Child Transmission
PPV	Positive Predictive Value
RCT	Randomised Controlled Trial
STI	Sexually Transmitted Infection
SQL	Structured Query Language
TasP	Treatment as Prevention
TANESA	Tanzania-Netherlands Support programme on AIDS
TAZAMA	Tanzania AIDS Monitoring Activities
UNAIDS	Joint United National Programme on HIV/AIDS
VCT	Voluntary Counselling and Testing
WHO	World Health Organisation
WI-HTC	Walk-in HIV Testing and Counselling

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1 Introduction

1.1 Background

Southern and Eastern Africa remains the region most affected by the HIV pandemic, accounting for just over 5% of the world's population but approximately 50% of all people living with HIV, corresponding to 17.1 million of the estimated 34.0 million people living with HIV in 2011 (1). In Tanzania, 1.4 million people were living with HIV in 2013, and prevalence among adults aged 15-49 was estimated at 4.9% (range 4.6-5.3%) (2). The vast majority of new infections in sub-Saharan Africa are acquired via heterosexual transmission (3).

HIV testing and counselling (HTC) services are promoted as the gateway to HIV care and treatment services, and offer the opportunity for specially-trained counsellors to encourage avoidance of high risk sexual behaviours among both HIV-negative and HIV-positive individuals. Since the mid-1990s, the traditional model of HTC service delivery in Tanzania and elsewhere in sub-Saharan Africa has been via client-initiated voluntary counselling and testing (VCT), with the emphasis originally being on counselling for HIV prevention, or linkage of positive persons to palliative care and other social support services, in the absence of widely available antiretroviral therapy (ART) (4-6).

Since the start of ART rollout across sub-Saharan Africa in the early to mid-2000s, in response to low initial rates of testing uptake as well as in recognition that many opportunities to diagnose individuals attending health facilities were being missed, policies and programmes for provider-initiated testing and counselling (PITC) in clinical settings have been increasingly adopted (7). In 2007 the WHO and UNAIDS published guidance recommending the scale-up of opt-out PITC alongside traditional VCT services, although by this time approximately 50% of African countries were already offering PITC - mainly in antenatal clinics, but also in clinics providing diagnosis, care and treatment for tuberculosis and sexual transmitted infections (STI), and other health facility settings where patients presented with HIV-like symptoms (8). In Tanzania, guidelines recommending the introduction and scale-up of PITC were published in 2007 (9), following a national programme for provision of free ART which started in October 2004.

Over the past ten years, other alternative and innovative options for HTC service delivery have evolved across sub-Saharan Africa, including mobile VCT, home-based VCT and VCT services offered to individuals in their local communities or places of work (10). These services have been associated with considerable increases in the uptake of HIV testing (11), although they have usually been offered as part of research or other projects, and have not generally been taken to scale as part of national-level policy.

In line with trends in other African countries, the number of facilities providing HTC services in Tanzania has increased substantially over the past 20 years. By the end of 2012, there were 2,168 sites across Tanzania providing HTC services, and PITC programmes (primarily antenatal testing of pregnant women) had been implemented at all hospitals and approximately 50% of health centres (12). Impressive as this roll-out is, it is worth remembering that more than 80% of the population in Tanzania are served by health centres and rural dispensaries (12) – that is they do not live in areas that can directly access hospital services. Nevertheless, the increase in the number of facilities providing HTC has seen a corresponding rise in HTC coverage rates. The proportions of men and women aged 15-49 in Tanzania who had ever tested for HIV increased from 15.4% and 15.2% respectively in 2003-2004 (13) to 27% of men and 37% of women in 2007-2008 (14), and 47% of men and 62% of women in 2011-2012 (15). However, in 2011-2012, the proportions of men and women reporting recent HTC (in the last 12 months) - a better indicator of knowledge of current HIV-status compared to reports of ever testing - were just 25.0% and 29.5% respectively (15), and Tanzania is among the countries with the poorest overall coverage of antiretroviral therapy (ART) in sub-Saharan Africa, with less than 60% of those eligible for treatment receiving it based on 2010 WHO treatment guidelines (1). Challenges to the uptake of HTC in Tanzania include low utilisation of services in rural areas (12), fear of HIV-related stigma and discrimination (16), a perceived lack of confidentiality associated with HIV testing (17), and fears surrounding disclosure of sero-status to partners and others (18, 19). Challenges to service provision include a lack of trained healthcare workers, a weak health system infrastructure and poor drug distribution systems leading to frequent stock-outs of HIV test kits and other supplies (12).

A note on terminology

A wide variety of terms are used to describe HTC services. The WHO and other international public health organisations use HTC as an umbrella term to refer to all types of testing and counselling services, whether they take the form of client-initiated voluntary counselling and testing (VCT), or opt-in or opt-out provider-initiated testing and counselling (PITC) (20). Client-initiated VCT can be further distinguished as services provided at clinics attached to health facilities, at stand-alone centres, or as temporary outreach services provided within villages or places or work. In this thesis, HTC is similarly used as an umbrella term, while the more specific terms are used to distinguish between types of services where relevant.

1.2 Rationale

HTC services are hypothesized to contribute to HIV-prevention by encouraging changes in sexual risk behaviour among both HIV-negative and HIV-positive individuals, following the development of an individualised risk reduction plan under the guidance and support of a trained counsellor (5, 21). However, previous quantitative and qualitative research in sub-Saharan Africa has provided mixed evidence for sexual risk reduction following HTC use. Quantitative studies provide moderate evidence for reductions in some sexual risk behaviours following HTC, such as changes in condom use or reductions in numbers of sexual partners, but suggest that changes in behaviour may be greater among individuals testing HIV-positive compared to those testing negative (22-24). However, there is considerable heterogeneity in study findings, and not all studies have stratified results by HIV-status. Furthermore, there is uncertainty regarding the extent to which the availability of treatment may affect patterns of sexual risk behaviour in sub-Saharan Africa (25), and whether any impacts of HTC on sexual behaviour may differ before and after the widespread availability of ART. A limited number of qualitative studies have explored understandings of and responses to HIV prevention counselling messages among individuals completing HTC, however many of these have focussed on HIV-positive individuals (26-29), despite the fact that HIV-negative individuals comprise the majority of the population and it is their behaviour that represents an opportunity for the primary prevention of HIV. Further qualitative research may help to shed light on the factors influencing sexual behaviour following HTC use, particularly among individuals testing HIV-negative.

Interest in the widespread use of ART in order to prevent HIV transmission by reducing viral loads in treated patients (treatment as prevention or TasP) has grown in recent years, following greater availability of ART across sub-Saharan Africa, and data from observational research, clinical trials and modelling studies which have demonstrated potentially great reductions in HIV incidence associated with TasP (30-32). In 2013, the WHO revised its treatment guidelines to recommended earlier ART initiation for several groups of patients, including all patients with a CD4 count ≤ 500 cells/ μL , and immediate provision of ART for all sero-discordant couples, pregnant women living with HIV, people with HIV and tuberculosis or HIV and hepatitis B co-infections, and all HIV-positive children under five years old (33). These revised guidelines (compared to earlier guidelines which recommended treatment initiation at CD4 counts ≤ 350 cells/ μL – (34)) will lead to substantial increases in the number of people eligible for treatment and requiring access to HTC as the point of diagnosis. Some countries in sub-Saharan Africa are beginning to roll out forms of TasP, while several countries are already implementing Option B+ (immediate ART for life for HIV-positive pregnant women) (35). In Tanzania, guidelines on the implementation of Option B+ were published in 2013 (36).

TasP strategies advocate regular repeat testing among high-risk individuals in order to diagnose HIV-positive patients and link them to treatment services as soon as possible after infection, reducing the period in which the risk of HIV transmission is greatest (30). As the numbers of people accessing HTC services increase, there is therefore a need to understand rates of repeat testing in sub-Saharan Africa. There is also a need to monitor and evaluate the relative success of different HTC service delivery models in attracting clients with high-risk behaviours known to be associated with HIV acquisition (such as greater numbers of sexual partners (37), unprotected sex (38) or early sexual debut (39)), as well as in improving early HIV diagnosis rates. Previous research in African settings suggests that overall, uptake of HTC is lower in rural compared to urban areas (40, 41), and that outreach HTC strategies such as mobile or home-based HTC result in greater uptake of HIV testing compared to health facility based services (11). However, the relative success of different testing modalities in attracting high-risk individuals or those at early stages of HIV infection is less well documented.

1.3 The research setting

This PhD research was conducted within the context of the Kisesa HIV community cohort study, a collaborative research project ('TAZAMA' - Tanzania AIDS Monitoring Activities) between the Tanzania National Institute of Medical Research (NIMR) in Mwanza, northwest Tanzania and the London School of Hygiene and Tropical Medicine (LSHTM), UK. The TAZAMA project aims to monitor the HIV epidemic in Kisesa and to describe incidence, prevalence and HIV-related mortality and their demographic correlates. The project has also been monitoring the implementation of an HIV treatment programme in Kisesa since it started in 2005.

The Kisesa cohort study is funded by the Global Fund to Fight AIDS, Tuberculosis and Malaria, and the principal investigators are Mark Urassa and John Changalucha at NIMR Mwanza, with technical assistance from Basia Zaba and others at the LSHTM. The primary research activities conducted by TAZAMA include rounds of demographic and serological surveillance (sero-surveys) which have been conducted in the study area since 1994 (initially a collaboration between the Tanzania-Netherlands Support programme on AIDS – TANESA, funded by the Royal Dutch Tropical Institute). Mobile or community-based outreach HTC services have been provided to sero-survey participants in temporary purpose constructed huts during all sero-survey rounds since 2003-2004. Further details of the research activities conducted as part of the Kisesa cohort study are provided in Chapter 3.

In addition to the research activities, a partnership also exists between TAZAMA and government-run health facilities in the study area, including HTC clinics (a voluntary client-initiated walk-in HTC or VCT clinic, as well as PITC offered primarily to pregnant women attending the antenatal clinic), and an HIV care and treatment clinic (CTC) located at Kisesa Health Centre. The project also partners with a CTC at Bugando Medical Centre, a zonal referral hospital in Mwanza city, and three rural dispensaries which are located in the study area. Recent goals of the TAZAMA project include monitoring the demographic impacts of the HIV epidemic, and the linkage of the community cohort research datasets to data from the Kisesa-based health facilities, in order to monitor the use and impact of HIV services.

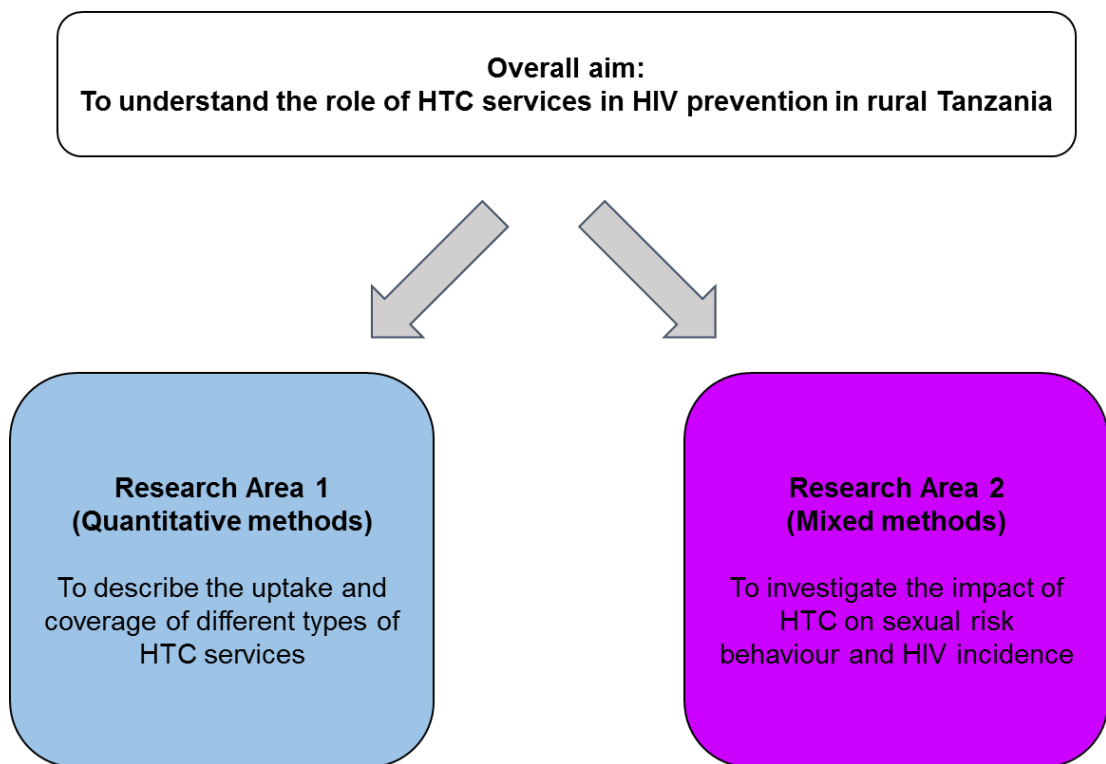
Long-term observational HIV cohort studies such as that conducted in Kisesa offer a unique opportunity to explore trends in HTC uptake as well as risk factors associated with service use, given the availability of data on HTC use, HIV-status, and other socio-demographic and behavioural characteristics over extended periods of time. In addition, the linkage between the routinely collected HTC clinic datasets at government-run health facilities and the research datasets allows for comparisons in rates of testing uptake and risk factors associated with use of different types of services to be made, in addition to estimations of service coverage at the community level. Kisesa is a rural ward that can be considered typical of many rural settings in Tanzania, thus the research findings are expected to be applicable elsewhere in Tanzania and other similar contexts across sub-Saharan Africa.

1.4 Aims and objectives of the research

The overall aim of the analyses presented in this thesis is to understand the role of HTC services in HIV prevention in Kisesa. The specific objectives cover two broad areas of research (see Figure 1.1). The first of these relates to describing the uptake and coverage of different types of HTC services, with uptake being defined as usage of testing services, while coverage refers to the proportion of the population who have ever accessed testing services. Quantitative research methods are used to investigate these topics.

The second area of research involves investigating the role of HTC in sexual behaviour change, using both quantitative and qualitative methods. The quantitative analyses investigate changes in reported sexual risk behaviours and HIV incidence before and after using a community-outreach HTC service, while the qualitative research adds depth to the quantitative findings by exploring perceptions of HTC services, and how HIV prevention counselling messages might influence attitudes and intentions regarding sexual risk reduction following HTC use.

Figure 1.1 Broad research aims of the thesis



The specific research objectives are as follows:

1. To explore the uptake and coverage of different types of HTC services in Kisesa between 2003 and 2010 (community outreach HTC (CO-HTC), client-initiated or walk-in HTC (WI-HTC) and antenatal testing of pregnant women (ANC-HTC)), by describing the proportions of individuals using each type of service and the socio-demographic, behavioural and clinical characteristics associated with service use.
2. To investigate trends in characteristics associated with CO-HTC use between 2003 and 2010, and to explore rates of repeat testing among HIV-negative and HIV-positive individuals, as well as risk factors for repeat CO-HTC use.
3. To synthesize the evidence for an impact of HTC on sexual behaviour change and HIV incidence in sub-Saharan Africa.
4. To quantitatively evaluate the impact of CO-HTC on changes in reported sexual risk behaviours among HIV-negative and HIV-positive individuals, as well as changes in HIV incidence, before and after the widespread availability of ART.

5. To explore perceptions of HTC services, and to understand how HIV prevention counselling messages might influence attitudes and intentions regarding sexual risk reduction.
6. To develop policy recommendations to improve the uptake, coverage and impact of HTC services among rural populations in Tanzania and elsewhere in sub-Saharan Africa.

Table 1.1 below summarises the research objectives as they were investigated in the thesis, showing the methods and data sources used for each.

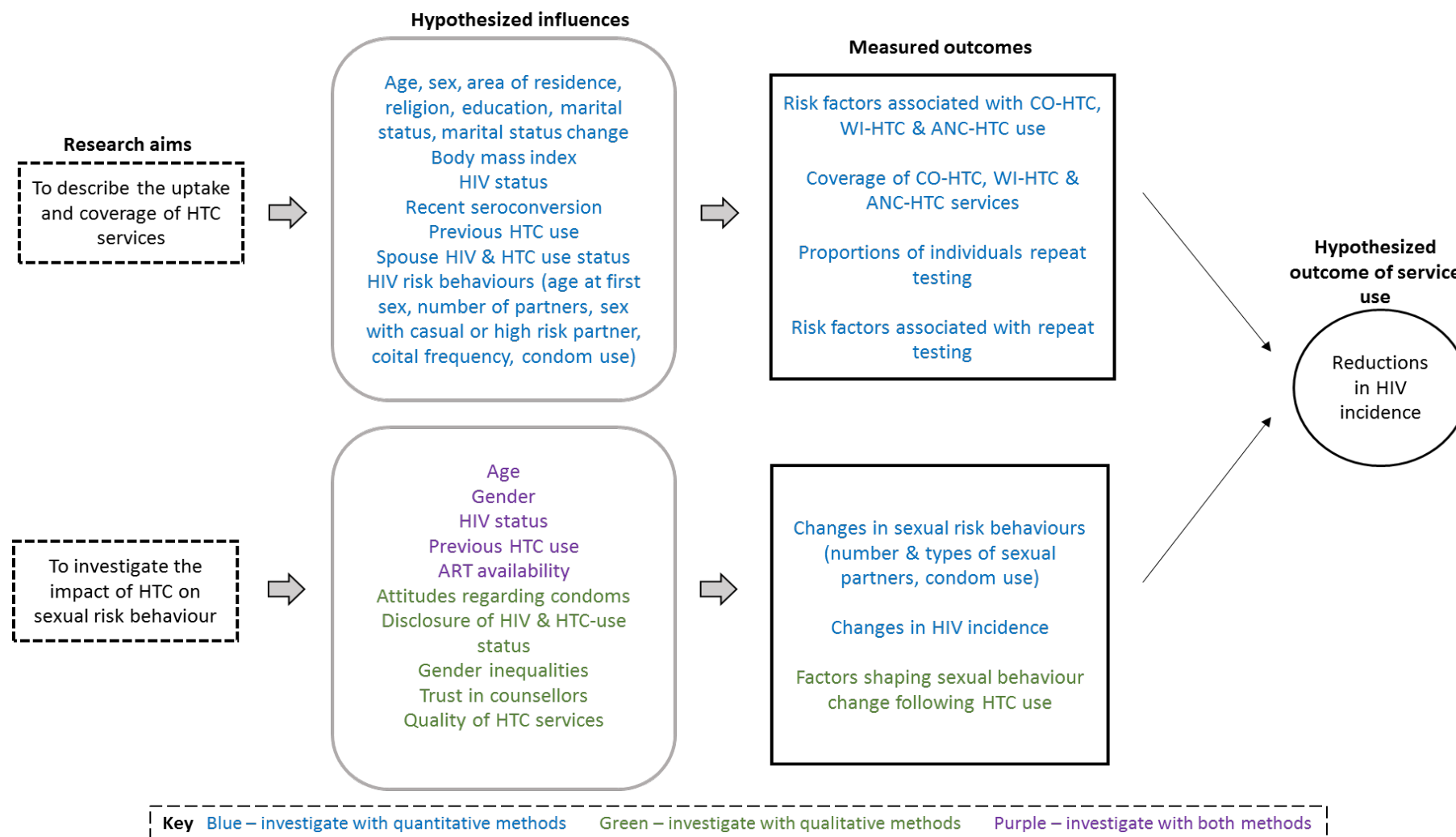
Table 1.1 Summary of research objectives, methods and data sources

	Research objectives	Methods	Data sources	Chapter in thesis
1	To explore uptake and coverage of different types of HTC services in Kisesa (CO-HTC, WI-HTC, ANC-HTC) between 2003 and 2010	Quantitative statistical analysis	Community cohort (demographic surveillance & HIV sero-survey) data linked to HTC-use datasets	Chapter 4 (Paper A)
2	To investigate trends in characteristics associated with CO-HTC use between 2003 and 2010, and to explore rates of repeat testing among HIV-negative and HIV-positive individuals, as well as risk factors for repeat CO-HTC use	Quantitative statistical analysis	Kisesa cohort and linked CO-HTC use datasets	Chapter 5 (Paper B)
3	To synthesize the evidence for an impact of HTC on sexual behaviour change and HIV incidence in sub-Saharan Africa	Systematic review of quantitative evidence	Bibliographic databases (Medline and Embase) - existing literature	Chapter 2
4	To evaluate the impact of CO-HTC on changes in reported sexual risk behaviours and HIV incidence before and after the widespread availability of ART in Kisesa	Quantitative statistical analysis	Kisesa cohort and linked CO-HTC use datasets	Chapter 6 (Paper C)
5	To explore perceptions of HTC services, and to understand how HIV prevention counselling messages might influence attitudes and intentions regarding sexual risk reduction	Qualitative study in Kisesa	Transcripts of in-depth interviews and participatory group activities, field notes	Chapter 8 (Paper D)
6	To develop policy recommendations to improve the uptake and impact of HTC services among rural populations in Tanzania and elsewhere in sub-Saharan Africa	Synthesis of all the research presented in the thesis	Systematic literature review (Chapter 2) Papers A-D (Chapters 4, 5, 6 and 8)	Chapter 9

1.5 Conceptual framework for the thesis

Figure 1.2 below shows a conceptual framework for understanding the role of HTC services in HIV prevention in Kisesa, incorporating the measured outcomes under the two main areas of research, namely i) describing the uptake and coverage of HTC services in Kisesa, ii) investigating the impact of HTC on changes in sexual risk behaviours among HIV-negative and HIV-positive individuals. Based on a review of the literature as well as findings from previous studies in Kisesa (42, 43), the hypothesized influences on the research outcomes (uptake of HTC, or sexual behaviour change) are summarised. Hypothesized influences and measured outcomes which are highlighted in blue represent those which will be investigated using quantitative methods. Hypothesized influences and outcomes highlighted in green will be investigated using qualitative methods, while influences which will be explored using both quantitative and qualitative methods are highlighted in purple. The ultimate aim of the research is to understand how to maximise the contribution of HTC to HIV-prevention efforts in rural Tanzania and other similar settings in sub-Saharan Africa.

Figure 1.2 Conceptual framework for understanding the role of HTC services in HIV prevention in Kisesa



1.6 Structure of the thesis

This thesis is presented in research paper style, including four published or submitted academic papers (Papers A-D) and five additional chapters including this introductory chapter. A short introductory section is provided before each research paper, briefly outlining the rationale for the paper and linking it to findings presented in preceding chapters.

Chapter 2 reviews the literature that is relevant to the research presented in this thesis, including a brief history of HTC service provision in sub-Saharan Africa, a review of HTC service provision modalities and the characteristics of users of different types of services, and a systematic literature review of the quantitative evidence for an impact of HTC on sexual behaviour change and HIV incidence in sub-Saharan Africa. Chapter 3 summarises the quantitative research methods, including further details on the research setting and a description of data management and preparation for the primary and secondary data sources used in Chapters 4, 5 and 6.

Chapter 4 is a research paper (Paper A) submitted to Tropical Medicine and International Health, and investigates risk factors associated with the use of different types of HTC services in Kisesa (CO-HTC, WI-HTC and ANC-HTC), as well as trends in the overall uptake of testing services between 2003 and 2010. This is followed by another paper (Chapter 5 – Paper B, published in PLOS ONE) which adds to these analyses by exploring trends in risk factors associated with CO-HTC use over the same time period, as well as rates of repeat testing and risk factors for repeat CO-HTC use between 2006 and 2010.

Chapter 6 (Paper C), published in BMC Infectious Diseases, is a quantitative analysis assessing the impact of CO-HTC use on changes in reported sexual risk behaviours and HIV incidence in Kisesa between i) 2003/2004 and 2006/2007 (when ART was available in Mwanza city, but not within Kisesa itself) and ii) 2006/2007 and 2010, when ART was available at a local CTC within the study area.

Chapter 7 provides details of the qualitative research methods, including a description of the data collection tools used during a period of fieldwork in Kisesa in 2012, the sampling and recruitment strategies used, and methods of data analysis. This is followed by Chapter 8, a qualitative paper submitted to *AIDS and Behavior*, which explores perceptions of HTC services and the factors which shape attitudes and intentions regarding sexual risk reduction following HTC use in Kisesa.

The thesis concludes with a discussion (Chapter 9) of the main findings from the PhD research, including a blended synthesis of findings from both quantitative and qualitative analyses. The strengths and limitations of the research are also discussed, as are programme and policy recommendations which will be relevant to policy makers in Kisesa and other similar rural settings in Tanzania. Recommendations for future research are also highlighted. The appendices include all the study tools, ethical clearance certificates, and disseminated work including posters and slides presented at international conferences.

1.7 Role of the candidate

I contributed to the design and framing of the overall objectives and research questions for this study. Because the research was conducted within the context of the TAZAMA Project, colleagues at the LSHTM and NIMR Mwanza were also involved in ideas and design for the study. My role in the quantitative and qualitative analyses completed as part of this thesis are outlined below.

1.7.1 Quantitative data collection and analysis (Papers A, B and C)

The quantitative analyses presented made use of both primary and secondary datasets. The secondary data came from rounds of demographic and serological surveillance carried out in the study area between 2003 and 2010. I was responsible for linking the demographic and sero-surveillance datasets, extracting, generating and cleaning the relevant variables, and designing and conducting the analyses. Although I was not responsible for the design or management of the sero-surveys, I provided feedback on the Sero7 and Sero8 questionnaires, particularly with reference to the questioning on HTC. I also attended two ALPHA (Analysing Longitudinal Population-based HIV/AIDS data on Africa) workshops in 2010 and

2011, which provided me with training on methods of data management and analysis techniques.

The primary dataset used in this thesis constituted data from a walk-in HTC clinic at Kisesa Health Centre which was linked to the Kisesa cohort research dataset. Part of the WI-HTC clinic data (up to June 2010) had already been entered, however I coordinated further work to update the data entry to cover the period 2010 to 2012. The additional data entry was overseen by a senior data manager at NIMR (Clemens Masesa), however I identified the relevant logbooks for data entry, advised on the design and creation of data entry screens as well as the development of edit checks, and I merged and cleaned the final WI-HTC clinic datasets used in analyses. The design of the algorithm to link the HTC clinic data to the cohort research dataset was initially led by an IT consultant at NIMR (Benjamin Clark), however I was involved in various stages of model development (further details of my role in the data linkage project are provided in Chapter 3).

I wrote the manuscripts for Papers A, B and C, incorporating feedback from co-authors and peer reviewers. Advice and guidance on the analyses was also provided from statisticians on my advisory panel at the LSHTM and NIMR including Jim Todd, Emma Slaymaker and Georges Reniers.

1.7.2 Qualitative research (Paper D)

I designed and led the qualitative study which was conducted in Kisesa in 2012, with advice and guidance from senior social scientists on my advisory panel at NIMR (Joyce Wamoyi) and the LSHTM (Shelley Lees). This included obtaining ethical approval for the study, designing the sampling frame using the demographic and sero-surveillance datasets, developing and piloting the data collection tools, training four research assistants with the support of senior social scientists, and analysing the data. I wrote the manuscript and developed the conceptual framework for Paper D, incorporating feedback from co-authors.

1.8 Ethical clearance

The research included in this thesis was approved by the ethics committee of the London School of Hygiene & Tropical Medicine and the Tanzanian Medical Research Coordinating Committee (see Chapters 3 and 7 for further details, and ethical clearance certificates in Appendix 11.1).

1.9 Funding sources

I was awarded a three year studentship from the UK Economic and Social Research Council which covered the cost of my research degree fees as well as an annual stipend and part of my fieldwork costs. I was awarded a £5,000 grant from the Gordon Smith Travelling Scholarship of the LSHTM which covered additional fieldwork costs and the costs of my travel to Tanzania. The ongoing TAZAMA cohort activities are funded by the Global Fund to fight AIDS, Tuberculosis and Malaria, with additional funding from the Bill and Melinda Gates Foundation (via the ALPHA Network) and the US National Institutes of Health (via the East Africa IeDEA (International Epidemiologic Databases to Evaluate AIDS) consortium).

2 Literature review

This chapter summarises the literature that is relevant to the research presented in this thesis. The first section provides of a brief history of HTC service provision in sub-Saharan Africa. This is followed by a section exploring the relative success of different HTC service delivery models in increasing the overall uptake of testing, and the socio-demographic, behavioural and clinical characteristics of users of different types of services. This informs the analyses presented in Chapter 4 (Paper A), which investigates risk factors for HTC service use in rural Tanzania. Section 2.3 explores rates of repeat testing in sub-Saharan Africa, which are important to understand given recent interest in TasP strategies, as well as the characteristics of those who return to test more than once - topics which are investigated in Chapter 5 of this thesis (Paper B).

Previous reviews of the impact of HTC on changes in sexual risk behaviour and HIV incidence have focussed on developed countries, or on developing countries including those outside of Africa, and only include studies published up to 2010. Section 2.4 presents a systematic review of the quantitative evidence for an impact of HTC on sexual risk reduction and HIV incidence in sub-Saharan Africa, incorporating studies published up to the end of 2014. This review informed the analyses presented in Chapter 6 (Paper C), which explore the impact of community-based outreach VCT on sexual risk behaviours and HIV incidence in Kisesa. In section 2.5.1, a brief overview of theories of behaviour change are presented. This is followed by a summary of qualitative findings relating to perceptions of HIV prevention counselling messages among individuals completing HTC in sub-Saharan Africa, in order to contextualise the qualitative research presented in Chapter 7 (Paper D).

2.1 A brief history of HTC service provision in sub-Saharan Africa

The first antibody test for HIV became widely available in industrialised nations in the mid-1980s. Initial approaches to HIV testing emphasized that it should be client initiated and done voluntarily, and were shaped strongly by activism in the Western

world which underscored the need for protection of the human rights of those infected with a highly stigmatised and untreatable condition (44). Counselling was proposed as a critical component of the VCT process. During pre-test counselling patients could be reassured that test results would remain confidential and fully informed consent could be obtained. Post-test counselling provided an opportunity to offer emotional and psychological support, to help clients understand the significance of their test results (whether negative or positive), and to plan for the future including reducing the risk of acquiring or transmitting HIV (45).

There is a paucity of evidence to guide the design of VCT interventions in developing countries and in sub-Saharan Africa specifically, however, these have generally evolved from the same set of principles guiding VCT service provision in developed countries (46, 47). A key hypothesis underscoring HTC service provision globally is that it can contribute to HIV-prevention by helping clients to initiate or maintain safe sexual behaviour (4, 5). However, policy documents have acknowledged that the impact of HTC on sexual behaviour change may be difficult to measure, due to the complex nature of sexual behaviour and partnerships in many high prevalence settings (21).

With the advent of antiretroviral therapy (ART) for the treatment of HIV in the mid to late 1990s, policy documents began to highlight the importance of HIV testing and counselling (HTC) not only for HIV prevention, but also in linking HIV-positive individuals to treatment and care (47). By the early 2000s, international organisations were examining ways to rapidly increase the number of people accessing HTC services and to scale up ART provision in sub-Saharan Africa, where the burden of HIV infection is greatest. Debates ensued about 'opt-in' versus 'opt-out' approaches to testing, coming respectively from human rights and public health perspectives (44). However, in recognition that many opportunities to counsel and diagnose individuals attending health facilities were being missed (7), in 2007 the WHO and UNAIDS published guidance on PITC to be offered by healthcare workers within existing clinics and health facilities (48). The PITC guidelines supported the continued scale-up of client-initiated VCT, but recommended opt-out PITC for patients attending health facilities whose clinical presentation might result from underlying HIV infection (irrespective of epidemic setting), and as a standard part of medical care for all patients attending health facilities in generalised epidemic

settings. The guidance noted that PITC should be accompanied by a package of HIV-related prevention, treatment, care and support services, and implemented within the framework of a national plan to achieve universal access to ART for all those who need it (48).

Subsequent to a number of international policy declarations which sought to reduce the impact of the global HIV epidemic and to dramatically increase the number of HIV-positive patients accessing treatment (49-51), by the mid-2000s vast resources had been mobilised to increase access to HTC and ART in sub-Saharan Africa (1). Alongside traditional stand-alone VCT services and PITC approaches, a number of alternative models of HTC service delivery have evolved, including VCT provided as temporary mobile or outreach services, or to people within their homes or places of work (7, 10). At the same time rapid testing technologies emerged, allowing for same day delivery of test results using simplified approaches such as finger-prick blood or oral fluid specimens (52).

In recent years, there has been renewed enthusiasm for expanding access to HIV testing and treatment services in light of research which has shown that HIV-positive individuals are significantly less likely to transmit infection to their sexual partners if their viral loads are suppressed as a result of receiving ART (31, 53). One modelling study hypothesized that the TasP approach could contribute to dramatic declines in HIV incidence if all adults aged 15 or older in high prevalence settings tested regularly (once per year), and if those testing positive initiated ART immediately after diagnosis (30). The success of TasP, if implemented at policy level, will ultimately depend on the ability of health systems to achieve near universal rates of HTC uptake, and to ensure strong systems for linking and retaining HIV-positive individuals in treatment and care.

2.2 Scale-up of HTC service provision: types of services and characteristics of service users

While there have been dramatic and encouraging increases in the numbers accessing HTC in sub-Saharan Africa in the last fifteen years, there is considerable regional variation in uptake. Data from Demographic and Health Surveys (DHS) and AIDS Indicator Surveys (AIS) carried out between 2006 and 2011 show that the

percentage of adult men and women who have ever tested for HIV ranged from less than 30% in Uganda to more than 70% in Rwanda (1). In Tanzania, data from an AIDS Indicator Survey in 2011-2012 showed that 47% of men and 62% of women reported ever having tested for HIV (15). This represents an encouraging increase in uptake from 27% of men and 37% of women reporting ever having tested in 2007-2008 (14). However, at least 38% of women and more than half of men in the 2011-2012 survey could not have been aware of their status, as they had never tested for HIV. In Tanzania and elsewhere, further substantial increases in the uptake of testing are required in order to maximise the potential prevention benefits of HTC, and to further increase the number of HIV-positive patients receiving treatment.

Several reviews have noted that PITC has contributed to substantial increases in HIV-testing across sub-Saharan Africa, with much of this attributed to the testing of pregnant women in antenatal clinics (8, 54-56). Some studies have highlighted concerns that opt-out testing during PITC can lead to coercion, with clients reportedly being unable or unaware of the right to decline testing (57, 58). However, other studies have found that rates of client satisfaction, consent and confidentiality did not differ between VCT and PITC services (59), and that PITC may help to 'normalise' HIV testing by eliminating the stigma associated with self-identifying oneself as at risk of HIV infection (60).

Mobile and community-based outreach VCT services have also been found to substantially increase the uptake of HIV testing in comparison to standard facility-based VCT services, and have been met with high rates of acceptability (61-64). Such services help to reduce the logistical (such as time and transport) and financial barriers to accessing testing (65, 66), and some studies have reported that they compare favourably with facility-based VCT services in terms of cost-effectiveness (64, 67). Studies assessing the usage of home-based VCT have also found high rates of acceptability and uptake (68-70), and this type of service can reduce concerns relating to confidentiality and stigma, as testing is provided within the privacy of the home (71, 72).

Recently there has been growing interest in self-testing for HIV (73). As a new and emergent technology, its feasibility and acceptability as well as ethical aspects

relating to its use are not well understood, particularly in African settings. However, one study in an urban setting in Malawi found an oral-swab self-test to be highly accurate (99.2% accuracy – two false negative results) and acceptable (all participants who agreed to test opted to use the self-test (followed by standard VCT with a trained counsellor), and 98.5% of self-testers rated the self-test ‘not hard at all to do’). This notwithstanding, participants articulated that counselling support was still needed following testing, and alternative counselling options such as a telephone helpline, information leaflets, or availability of a local community health worker were not considered acceptable substitutes (74). Globally, very few countries have adopted policies regarding self-testing (although Kenya is one of them – (73)), and there is a lack of evidence surrounding its efficacy and appropriateness for use in a rural African setting such as Kisesa. Nevertheless, initial studies in African settings have indicated that self-testing warrants further exploration as a potential way to make progress towards meeting universal access goals (74, 75).

A number of studies have reported on the general socio-demographic, behavioural and clinical characteristics of individuals who report ever having tested for HIV (40, 41), however few have compared the characteristics of individuals who use different types of testing services. Some studies have suggested that mobile or community-based VCT may help to reach comparatively older and less educated clients compared to health facility-based VCT or PITC (76-79). However, one study reported that the age distribution of clients using six stand-alone VCT centres compared to three different types of mobile VCT services were similar (64). Several studies have reported that men are less likely to use health facility-based HTC services compared to women (77, 79, 80), although few have reported which strategies might be most effective in promoting couples-testing.

Some studies have found VCT use to be associated with higher risk sexual behaviours (42, 81), however there is a lack of literature to compare the sexual risk profiles of individuals across different types of services. A number of studies have reported that HIV prevalence is higher among individuals testing at health facility-based services compared to outreach VCT services (64, 67, 69, 77, 79). While there is some evidence that mobile and home-based VCT services may help to diagnose HIV-positive individuals at earlier stages of infection (67, 77), this has not yet been widely documented, and relatively few studies have explored which types of HTC

services attract first-time and previously undiagnosed testers (64, 67). Further research is required in order to understand which HTC service delivery models are most effective at identifying HIV-positive individuals and those most at risk of infection, as well as whether different types of services help to increase the coverage of testing among different socio-demographic groups.

2.3 TasP and repeat testing

TasP approaches advocate regular repeat testing among individuals testing HIV-negative, in order to identify new HIV infections soon after sero-conversion (30, 82). However, few studies have explored rates of repeat testing in sub-Saharan Africa, or the characteristics of those who return for a second or subsequent test. One study offering home-based VCT in Uganda reported that only 24% of individuals accepted a repeat HIV-test during rounds of annual demographic and health surveillance (83). However, in another HIV cohort study in Malawi, a substantially larger proportion of participants (73.4%) accepted repeat home-based VCT during two surveys in 2004 and 2006 (84).

A small number of studies have explored the socio-demographic characteristics of individuals who have tested for HIV more than once. Some of these are similar to the characteristics of those who report ever having tested, with rates of repeat testing being greater among women (85-87), those aged 25-44 (43), those living in urban areas (43) and those with higher levels of education (85, 88). Other studies have shown that repeat testers have similar or increased sexual risk behaviours compared to those who have never tested (83, 88). This is encouraging in terms of the potential of HTC to pick-up those at greatest risk of HIV-infection, although does not lend support to the hypothesis that HTC encourages sexual risk reduction. One study in South Africa reported that median CD4 counts were significantly higher among HIV-positive individuals being diagnosed on their second or later HIV test compared to those diagnosed at their first test, providing some reassurance that repeat HIV testing may help to shorten the period between sero-conversion and diagnosis (86). However, further research is required in order to better understand the characteristics of those who repeat test, including whether these individuals are at higher risk of sero-conversion than those who don't test or who test only once.

2.4 Systematic review of the impact of HTC on sexual behaviour change and HIV incidence in sub-Saharan Africa

A number of early reviews assessed the evidence for an effect of VCT on sexual risk reduction in developed countries, mainly among men who have sex with men and intravenous drug users (89-91). These studies found that VCT was associated with decreases in sexual risk behaviour among HIV-positive individuals and sero-discordant couples, although evidence for an impact among HIV-negative individuals was less clear. More recent quantitative reviews have included data from low and middle-income countries (22, 23, 54), although none have focussed on sub-Saharan Africa specifically. A systematic review was conducted in order to investigate the quantitative evidence for an impact of HTC on changes in sexual risk behaviour and HIV incidence in sub-Saharan Africa.

Database searches were conducted in Medline and Embase, including studies published between 1st January 2000 and 31st January 2015. Both MESH term and keyword searches were used and the results were combined in order to maximise the number of potentially relevant results. The following search terms were used: ('Counselling' OR 'VCT' OR '(counsel?* adj3 test*)') AND ('HIV' OR 'human immun#deficiency virus' OR 'human immun#-deficiency virus' OR 'AIDS' OR 'acquired-immun#-deficiency-syndrome') AND ('Sexual Behavior' OR '(sex* adj3 (behavio?r* or risk* or practice*))') AND ('Africa south of the Sahara' OR 'Africa' OR 'Senegal' OR 'Gambia' OR 'Guinea' OR 'Sierra Leone' OR 'Liberia' OR 'Cote d-Ivoire' OR 'Burkina Faso' OR 'Ghana' OR 'Togo' OR 'Benin' OR 'Niger' OR 'Nigeria' OR 'Cameroon' OR 'Gabon' OR 'Congo' OR 'Angola' OR 'Namibia' OR 'Lesotho' OR 'Swaziland' OR 'Botswana' OR 'Zimbabwe' OR 'Mozambique' OR 'Malawi' OR 'Zambia' OR 'Tanzania' OR 'Kenya' OR 'Uganda' OR 'Rwanda' OR 'Burundi' OR 'Ethiopia' OR 'Somalia' OR 'Djibouti' OR 'Eritrea' OR 'Sudan'). In addition to the searches in Medline and Embase, the reference lists of articles meeting the review inclusion criteria were screened for relevant articles. Previous reviews and meta-analyses provided relevant background information.

In total 765 articles were retrieved from the database searches, as well as two additional articles from the review of reference lists of other papers. 722 articles

were excluded after review of the title or abstract, while 45 papers were reviewed in detail, 24 of which were found to meet the review inclusion criteria. One article was subsequently excluded as it reported earlier results included in a subsequent publication from the same study site, leaving 23 articles in the final review.

Studies were included which measured the impact of an HTC intervention (defined as HIV testing including receipt of results and pre and post-test counselling – whether this was provided in a VCT or PITC setting) on self-reported sexual behaviour outcomes (e.g. number and type of sexual partners, condom use) and/or the incidence of HIV or other sexually transmitted infections (STIs). The review included articles which made comparisons between participants before and after using HTC services, or between individuals who had and had not used HTC, in cross-sectional studies, cohort studies or randomised controlled trials (RCTs). Studies which made comparisons between individuals who received more and less intensive versions of HTC interventions were also included. Papers reporting attitudes towards risky sex and/or condom use rather than reported behaviours were excluded, as were studies where HTC was part of the study design but it was not possible to distinguish its effects from other study interventions. Qualitative data were not included as part of the systematic review, however a review of the qualitative literature exploring perceptions of or responses to HIV prevention counselling messages among individuals completing HTC in African settings is presented in Section 2.5.2 below.

The 23 studies included in the review are summarised in Table 2.1. The studies assessed the impacts of the following types of HTC interventions: i) VCT services provided to individuals at free-standing centres or within clinics attached to health-facilities, ii) outreach VCT services provided within mobile units, the home or the place of work, iii) health-facility based VCT services provided to couples, iv) PITC services offered to pregnant women or attendees at outpatients clinics. The findings from the review are synthesized below.

2.4.1 Studies assessing the impact of health facility-based VCT services

Three prospective studies recruited individuals from VCT clinics at health centres in Mozambique, Kenya and South Africa. These studies included both HIV-negative and HIV-positive individuals (but did not stratify results by HIV-status - (92, 93)), or HIV-positive individuals only (94), and found statistically significant reductions in the number of sexual partners and levels of unprotected sex reported four or six months after testing. A further prospective study assessed changes in sexual risk behaviour among initially HIV-negative participants returning for repeat testing at a free standing VCT clinic in Tanzania, with a mean period of 94 days between first and second tests (95). This study reported significant increases in the proportion of clients reporting no concurrent sexual partners (83.3% at first test versus 89.7% at second test, $p < 0.0001$) or any condom use in the past month (15.3% reporting any condom use at first test versus 21.0% at second test, $p < 0.04$).

2.4.2 Studies assessing the impact of outreach VCT services provided within the community, home or place of work

Four RCTs assessed the impact of community-based VCT interventions on changes in reported sexual risk behaviours and/or HIV incidence. The earliest of these recruited individuals and couples in Kenya, Tanzania and Trinidad between 1995 and 1998, and assessed sexual behaviour outcomes among participants randomised to receive either immediate (intervention arm) or delayed (control arm) access to VCT (96). Participants in the control arm received a health information intervention at baseline (a 15 minute video and participation in a discussion about HIV transmission and condom use), and were offered VCT at first and second follow-up at seven and 14 months respectively.

The trial found that among participants recruited as individuals (rather than as part of a couple), VCT had a significant impact in reducing unprotected sex with non-primary partners (OR 0.68, 95% CI 0.56-0.82, $p < 0.0001$). Among men, this effect was greater among HIV-positive compared to HIV-negative individuals (in intervention arm, 4.8% of HIV-positive men reported unprotected sex with a non-primary partner at first follow-up compared to 20.6% of HIV-negative men, $p < 0.0001$. This finding was maintained at second follow-up when 6.1% of HIV-

positive men reported unprotected sex with a non-primary partner compared to 16.5% of HIV-negative men, $p=0.006$). Among participants who were recruited into the study as couples, VCT resulted in reduced levels of unprotected sex with enrolment partners (but no differences in unprotected sex were found with non-enrolment partners), and this effect was greater where one or both members of the couple were HIV-positive. In the trial, the reductions in sexual risk behaviour achieved in the intervention arm were replicated in the control arm once this group had access to VCT at first follow-up. The validity of self-reported sexual behaviour data was also assessed by analysing the agreement of reports made by different members of the same couple, who were interviewed separately. This revealed high rates of agreement: 91% in the case of reports of coital frequency, and 88% in relation to reports of unprotected sex.

In another randomised trial, Coates et al investigated the impact of outreach VCT on HIV incidence (primary outcome) as well as on increasing the uptake of testing and reducing sexual risk behaviours among young people aged 18-32 in four countries (Tanzania, Zimbabwe, South Africa and Thailand) (97). In the intervention arm, outreach VCT was provided in easily accessible mobile units provided within the community and was accompanied by community mobilisation and post-test peer-based social support groups for both HIV-negative and HIV-positive individuals. Control communities received standard VCT services at existing district hospitals or health-care facilities. Although the intervention increased the uptake of testing by 25% ($p=0.0003$), there was only weak evidence for a statistically significant reduction in HIV incidence in the intervention arm compared to the control arm (RR 0.86, 95% CI 0.73-1.02, $p=0.08$). However, the reduction in HIV incidence was significant among women aged 25-32 (RR 0.70, 85% CI 0.54-0.90, $p=0.008$). In analyses conducted at the community level (including all residents in the target age group, not only those who had used VCT), there were no effects of the intervention on the reported number of unprotected sex acts. However, among HIV-positive individuals there was a significant reduction in the number of sexual partners, which was reduced by 8% in the intervention compared to control arm (95% CI 1%-3%, $p=0.034$). This effect was particularly strong among HIV-positive men, who reduced the number of partners by 18% (95% CI 5%–28%, $p=0.009$).

Two further cluster RCTs investigated the impact of workplace-based VCT in Zimbabwe (61) or home-based VCT in South Africa (98). The Zimbabwean study found no impact of workplace-based VCT compared to offsite VCT in reducing HIV incidence (adjusted relative risk (aRR) for sero-conversion: 1.49, 95% CI 0.79-2.80), although the uptake of testing was significantly greater in the intervention compared to the control arm (mean uptake per site 70.7% in workplace-based VCT arm versus 5.2% in offsite VCT arm, $p < 0.001$). The South African study similarly reported significantly higher uptake of VCT in the intervention compared to control arm (prevalence of HIV-testing 69% in home-based VCT arm compared to 47% in standard VCT arm, prevalence ratio 1.54, 95% CI 1.32-1.82). Results were not stratified by HIV-status, but the authors reported that the proportions of individuals reporting more than one partner or any casual partner in the past three months were significantly lower in the intervention compared to control arm (prevalence ratio for reporting more than one partner in the past three months: 0.45, 95% CI 0.33-0.62. Prevalence ratio for reporting any casual partner in the past three months: 0.55, 95% CI 0.42-0.73). However, there was no evidence for an impact of the intervention on increasing the proportion of respondents reporting condom use at last sex (prevalence ratio 0.86, 95% CI 0.65-1.15).

Four articles assessed the impact of HTC services using data from cohort studies, comparing outcomes among individuals who had and had not used HTC in Rakai, Uganda (83, 99), Manicaland, Zimbabwe (100) or KwaZulu-Natal, South Africa (101). The Rakai papers reported no impact of home-based VCT on self-reported sexual risk behaviours or HIV incidence among HIV-negative individuals, even when participants had received repeat VCT on two or more occasions. In Manicaland, Cremin *et al* found no impact of reported VCT use on sexual behaviour change among men, although they found that women who had previously tested either HIV-negative or HIV-positive reported a reduction in the number of new sexual partners in the last year as compared to women who didn't test, and women who tested positive also reported a reduction in the number of visits to a bar or beer hall in the last month (an activity associated with risky sexual behaviour). However, an adjusted analysis taking into account background declines in sexual risk behaviour over the study period (1998-2005) revealed no impact of VCT on sexual risk behaviour among HIV-positive women, and that women testing negative increased their bar attendance and numbers of partners in the last month compared to women who didn't test. However, the increases in both indicators were small and driven by

modest changes among a small number of HIV-negative women (Ide Cremin, personal communication June 2011). The South African cohort study reported that in adjusted analyses which took account of differences in underlying HIV risk, the hazard of HIV acquisition was significantly lower among young people aged 15-24 reporting previous HTC compared to those reporting no HTC (0.59, 95% CI 0.45-0.78) (101). It was reported that this effect was similar in the first 1.5 years after reported HTC use as in the next 3 years after HTC, among men and women, as well as among those aged less than 20 or aged 20 or older.

An additional cohort study evaluated the impact of HTC as part of a broader investigation of hormonal contraception and HIV, and found that women testing HIV-positive were twice as likely to report that all acts of sexual intercourse were protected 12 to 16 months after testing compared to before diagnosis (aOR 1.99, 95% CI 1.12-3.53), although among HIV-positive women reporting at least one unprotected act, the overall proportion of unprotected acts did not change (7% reduction, 95% CI -18 to +6%). Furthermore, there were no statistically significant reductions in reported sexual risk behaviours among women who tested HIV-negative (102).

Finally, three observational studies explored the impact of outreach VCT services in Zimbabwe, South Africa and Uganda (103-105). One of these reported that women who sero-converted during a reproductive health trial were more likely to report consistent condom use, and less likely to report having more than one sex partner, after diagnosis compared to before (104). The other two studies reported changes in some but not all sexual risk behaviours among individuals testing HIV-negative (103) or among both HIV-negative and HIV-positive participants (results not stratified by HIV-status (105) - see Table 2.1).

2.4.3 Studies assessing the impact of HTC on sexual behaviour change among couples

Three studies in Rwanda and Zambia recruited couples who were either married or cohabiting or had been in a relationship for at least six months (106-108). In the situation where at least one member of the couple tested HIV positive, all three

studies showed a statistically significant impact of VCT in reducing sexual risk behaviour. None of the studies included an untested control group and all were pre-post analyses of the intervention, with follow-up at either six or 12 months post-testing. However, one of the Zambian studies assessed the validity of self-reported sexual behaviours using biological markers (107). This corroborated the finding that VCT was associated with increased condom use, although also indicated that overall, at least half of all unprotected sex acts were not reported.

Two of the studies included an additional element provided alongside the VCT service. In the study in Rwanda, an extra focussed counselling session was provided for men (as they were considered to be the primary decision-makers in the relationship) (106). The study reported that the mean rate of unprotected intercourse decreased where one or both members of the couple tested HIV positive, but no statistically significant reductions in sexual risk behaviour were observed where both participants tested HIV negative.

One of the studies in Zambia recruited HIV-positive concordant or sero-discordant couples. Women received three additional risk-reduction counselling sessions after undergoing VCT, while men were randomised to receive either one or three additional risk-reduction counselling sessions (108). Reported consistent male condom use over the last seven days increased significantly in both arms of the study at 12-month follow-up. In couples where the male partner had tested HIV negative, reported consistent condom use increased more for men receiving three risk-reduction counselling sessions than for those who had received one.

2.4.4 Studies assessing the impact of PITC on sexual behaviour outcomes

Three studies assessed the impact of PITC offered at antenatal clinics in Kenya, Cote d'Ivoire and South Africa, while one assessed the impact of PITC offered at the outpatients department of a rural hospital in Uganda.

In the South African study, pregnant women attending an antenatal clinic were randomised to receive an enhanced or standard PITC service (109). The enhanced PITC intervention included a 15 minute video priming women around decisions relating to HIV testing and risk reduction, enhanced pre- and post-test counselling (using interactive techniques such as role-plays) and access to legal and support groups. Women in the control arm received standard PITC in accordance with South African national guidelines. The study reported no statistically significant effects of the intervention on incident STIs (*Trichomonas vaginalis*, *Neisseria gonorrhoea* or *Chlamydia trachomatis*) at 14 weeks post-partum among HIV-negative or HIV-positive women (results were stratified by HIV-status). The authors reported that across both treatment and control groups there were substantial reductions in past 30 day inconsistent condom use at 14 weeks and 9 months post-partum, among both HIV-negative and HIV-positive participants. However, the effect of the enhanced PITC intervention on inconsistent condom use was only statistically significant among HIV-negative women at the 9 month post-partum follow-up visit (RR 0.72, 95% CI 0.59-0.88, $p=0.001$).

Two observational studies assessed the impacts of PITC and the role of partner involvement on the uptake of HIV-prevention interventions among pregnant women in Kenya (110) and Cote d'Ivoire (111). In the Kenyan study, among 871 pregnant women who were sexually active between PITC and two week follow-up, the prevalence of reported condom use increased from 14% before testing to 38% at the follow-up visit ($p<0.001$) (110). However, there was no statistically significant increase in reports of condom use among 170 male partners who were also tested and returned at two week follow-up (16% before testing versus 19% after testing, $p=0.6$). Among HIV-positive women, couple counselling was associated with a trend for increased condom use (OR 6.5, 95% CI 0.77-55, $p=0.07$), however the opposite effect was seen among HIV-negative women who were counselled as part of a couple (OR 0.2, 95% CI 0.1-0.43, $p<0.001$) (97% of these women and their partners were concordant HIV-negative).

In Cote d'Ivoire, 710 women accepted PITC at seven different antenatal clinics (111). Among both HIV-negative and HIV-positive women, significantly larger proportions reported having ever used condoms with their regular partners at 18 months post-partum compared to before testing (HIV-negative women: 36.4% at

baseline versus 58.7% at follow-up, $p < 0.01$. HIV-positive women: 23.2% at baseline versus 48.8% at follow-up, $p < 0.01$). However, increases in the proportions of women using condoms consistently were much lower (statistical significance not reported).

Finally, one study assessed PITC among individuals waiting to see a clinician at the outpatient clinic of a rural hospital in Uganda (112). Results were stratified by HIV-status, and the study reported that among 215 participants who accepted testing and returned at three month follow-up, the percentage of both HIV-negative and HIV-positive people who reported engaging in risky sex (defined as unprotected sex with a partner of unknown or sero-discordant status) decreased at the follow-up visit. However, at three month follow-up more than 50% of all participants still reported engaging in risky sex, and among individuals who reported at least one risky act, only HIV-positive individuals decreased their average overall proportion of unprotected sex acts. There were also low rates of behaviour change reported by married or cohabiting couples in this study.

Table 2.1 Studies included in systematic review of impacts of HTC on sexual risk behaviour and HIV incidence in sub-Saharan Africa

Author & Ref	Setting and study design	Intervention & sero-status of participants	Outcome measures	Control grp	N*	Follow-up†	Key findings
Mola et al 2006 (92)	*Pre-post analysis of adults aged 18+ attending VCT clinics in Mozambique between 2002-2003 *Controls attended outpatient clinics (general medical care or antenatal clinics) in same cities	*Government run VCT clinics *HIV-ve & HIV+ve participants (results not stratified by HIV-status) *No further details on VCT service provided	Condom use	Yes	622 VCT users, 598 controls	4 & 6 mths	*VCT clients reported using condoms significantly more often than non-users of VCT in unadjusted analyses.
Arthur et al 2007 (93)	*Adults aged 18 or older, or married, recruited at health centre based VCT clinics in Thika & Nairobi, Kenya in 1999. *Pre-post analysis	*Government run VCT clinic *HIV-ve & HIV+ve participants (results not stratified by HIV-status) *Counselling sessions included personalised interactive counselling, risk assessment & coping strategies. Use of rapid tests. Condom demonstrations & free condoms provided.	Reported # of partners, condom use, STI symptoms	No	540	6 mths	*Significant reductions in # of clients with multiple partners, # reporting STI symptoms, levels of unprotected sex.
Peltzer et al 2010 (94)	*HIV+ve adults aged 18+ accessing 13 VCT clinics in Mpumalanga, South Africa in 2008-2009. *Pre-post analysis	*Government run VCT clinics *HIV+ve participants only *VCT with lay counsellors from local communities who had 2 wks training in HIV counselling. *Participants also received 3 x 30 min motivational-skills building risk reduction counselling sessions at ~0,1, 2 mths after VCT	Reported # of partners, coital frequency, condom use	No	488	4 mths	*Significant reductions in # individuals with multiple sex partners, unprotected sex, use of alcohol or drugs in the context of sex, transactional sex. *Significant increase in sexual abstinence during the last 3 mths
Fiorillo et al 2012 (95)	*Pre-post analysis among HIV-ve adults 18+ attending for repeat testing at VCT clinic in Tanzania between 2003-2008 *Structured questionnaire administered to clients attending 2 consecutive HTC visits	*Freestanding VCT clinic operated by a community group *HIV-ve participants only *VCT provided according to Tanzanian national guidelines using rapid HIV tests	Abstinence, concurrent sexual partners, condom use	No	951	94 days (range 24-1920)	*Reduction in proportion of men and women reporting concurrent partners *Increase in proportion of men and women reporting condom use in past month *No change in abstinence in last year
Voluntary HTC Efficacy Study Group, 2000 (96)	*RCT of individuals & couples aged 18+, or married, from 3 study sites in Kenya, Tanzania & Trinidad between 1995-1998 *Participants randomised to receive VCT or health information	*Standard VCT (intervention arm) vs health information only (control arm) *HIV-ve & HIV+ve participants (results stratified) *Test results & post-test counselling 2 weeks after blood sample. *Health information arm included 15 min video & discussion about HIV transmission. Participants in this arm offered VCT at 1st & 2nd follow-up at ~7 & 14 mths	Condom use, incident STIs	Yes	3,120 individuals 586 couples	7 & 14 mths	*Reductions in unprotected sex with non-primary partners significantly greater in intervention arm *Couples in intervention arm reduced unprotected sex with enrolment (but not non-enrolment) partners significantly more than couples in health information arm *Reductions in unprotected sex greater among HIV+ve individuals or where ≥1 member of couple was HIV+ve

*Number of individuals contributing to analysis of impact of HTC, unless stated otherwise

† Where outcome measures assessed at >1 follow-up, key findings reported for longest period of follow-up, unless stated otherwise

Table 2.1 continued

Author & Ref	Setting and study design	Intervention & sero-status of participants	Outcome measures	Control grp	N*	Follow-up†	Key findings
Corbett et al 2007 (171)	*Cluster randomised trial of intensive (on-site) vs standard (off-site) VCT at 22 businesses in Harare, Zimbabwe between 2002-2004 *Participants were initially HIV-ve individuals consenting to repeat testing at end of 2 yr intervention period	*Workplace VCT with same-day results (intervention arm) vs pre-paid vouchers for external VCT centres (control arm) *HIV-ve participants *VCT was provided according to WHO guidelines	HIV incidence	Yes	2,966	2 yrs	*Uptake of VCT significantly higher in intervention vs control arm, but no significant difference in HIV incidence between arms in crude or adjusted analyses
Doherty et al 2013 (98)	*Cluster randomised trial, participants aged ≥14 in 16 communities in KwaZulu Natal, South Africa *Communities randomised to home-based VCT or standard VCT at local clinics between 2009-2010	*Home-based VCT (HB-VCT) vs standard VCT (S-VCT) at local clinics *HIV-ve & HIV+ve participants (results not stratified by HIV-status) *Intervention arm included community mobilisation & HB-VCT delivered by lay counsellors. *S-VCT included services at local clinics & some non-governmental organisation mobile outreach VCT	# & type of partners, condom use at last sex	Yes	16 communities (4,154 participants)	x-sectional surveys at baseline & 18 mths	*Significantly lower proportion of men & women in intervention arm reporting >1 sex partner or a casual partner in past 3 mths compared to control arm *No effect of intervention on condom use at last sex
Coates et al 2014 (97)	*Cluster randomised trial between 2004-2011, participants aged 18-32. *34 communities at 4 sites in Africa (South Africa, Tanzania, Zimbabwe) & 14 communities in Thailand *Communities randomised to community based VCT or standard VCT at district health facilities	*Community based VCT (CB-VCT) vs standard VCT (S-VCT) at health facilities *HIV-ve & HIV+ve participants (results stratified) *CB-VCT included easily accessible VCT in mobile units, community mobilisation & post-test peer based social support groups *S-VCT consisted of services at existing district hospitals or local health-care facilities	HIV incidence, avg monthly # unprotected sex acts, # partners	Yes	34 communities (HIV incidence) 48 communities (sexual behaviour)*	x-sectional surveys at baseline & 36 mths	*Borderline significant lower HIV incidence in CB-VCT arm compared to S-VCT arm. Highly significant lower HIV incidence among women aged 25-32 *No effect on # unprotected sex acts among men or women. Significant reduction in # sex partners among HIV+ participants
Matovu et al 2005 (99)	*Open HIV cohort study offering VCT in Rakai, south-west Uganda. *Pre-post analysis of adults (15-49 yrs) who were HIV-ve in 1999 and also attended a sero-survey in 2000	*Home-based VCT *HIV-negative participants only *Pre-test counselling on benefits of individual & couple counselling after providing blood sample for research purposes. *Results and post test counselling available in ~1 month. Post-test counselling provided in the home or other venue of the participants' choosing	# partners, condom use, HIV incidence	Yes	6,088	12 mths	*No impact of VCT on subsequent risk behaviours or HIV incidence
Matovu et al 2007 (83)	*Open HIV cohort study offering VCT in Rakai, south-west Uganda. *Pre-post analysis of impact of repeat-testing among all HIV-ve adults (15-49) providing an interview & blood sample at two or more annual surveys from 1999	*Home-based VCT *HIV-negative participants only *Pre-test counselling on benefits of individual & couple counselling after providing blood sample for research purposes. *Results and post test counselling available in ~1 month. Post-test counselling provided in the home or other venue of the participants' choosing	# partners, condom use, HIV incidence	Yes	6,377	12 mths	*Individuals accepting repeat VCT less likely to change risk behaviour compared to those i) not using VCT ii) using VCT only once *No difference in HIV incidence between repeat-testers & those i) not using VCT ii) using VCT only once

*Number of individuals contributing to analysis of impact of HTC, unless stated otherwise

† Where outcome measures assessed at >1 follow-up, key findings reported for longest period of follow-up, unless stated otherwise

Table 2.1 continued

Author & Ref	Setting and study design	Intervention & sero-status of participants	Outcome measures	Contro l grp	N*	Follow-up†	Key findings
Cremin et al 2010 (100)	*Open HIV cohort study offering VCT in Manicaland, Zimbabwe *Pre-post analysis using data on reports of previous VCT use from 3 survey rounds (1998-2000, 2001-2003, 2003-2005) including men aged 17-54 & women aged 15-44 (first 2 rounds), or all adults aged 15-54	* Mobile village based VCT clinic * HIV-ve & HIV+ve participants (results stratified) *Free VCT after completing survey questionnaire. Test results & post-test counselling 2 weeks later (first 2 rounds) or rapid testing with same day results & post-test counselling (last round).	# partners, visits to beer hall, condom use	Yes	1,759	2-3 yrs	*No impact of VCT on sexual behaviour change among men (HIV+ve or -ve) *Reduction in # new sex partners in last year among women (HIV+ve or -ve) ^{&} *Reduction in # visits to beer hall in last mth among HIV+ve women ^{&}
Rosenberg et al 2013 (101)	*Cohort study assessing impact of HTC on HIV incidence among youth in South Africa *Study participants were HIV-ve, aged 15-24 and attended at least 2 rounds of an annual HIV survey between 2006-2011 *Study assessed HIV acquisition comparing those exposed and unexposed to HTC	* Reported previous HTC (any type of service - walk-in VCT, outreach VCT or PITC) * HIV-ve participants	HIV incidence	Yes	3,959	Annual surveys between 2006-2011	*In adjusted model, HIV incidence significantly lower in HTC exposed compared to unexposed youth *Reduction in incidence sustained up to 4.5 yrs after HTC, & similar among men & women
Turner et al 2009 (102)	*Study on effect of hormonal contraception on HIV acquisition & HIV genital shedding that included HTC data *HIV-ve women aged 18-35 recruited from FP clinics (Uganda, Zimbabwe) & from sex workers, military wives & STI clinic attendees (Uganda) between 1999-2004	* VCT offered as part of the study * HIV-ve & HIV+ve participants (results stratified) *All VCT sessions included pre- & post-test counselling & instructions on condom use. Counselling sessions for HIV+ve women slightly longer (45 mins) than HIV-ve women (30 mins) *Test results were usually received with ~10 days.	Condom use	No	801	6 & 16 mths	*HIV+ve women twice as likely to report that all sex acts were protected 12-16 mths after diagnosis compared to before *No change in the proportion of unprotected sex acts among HIV+ve women who used condoms inconcsistently *No significant reductions in unprotected sex among
Matambo et al 2006 (103)	*Pre-post analysis among HIV-ve participants receiving VCT at their workplace (11 business in Harare, Zimbabwe) between 2002-2004 *Questionnaire & risk assessment at time of VCT & 3 mths later	* Workplace VCT with same-day delivery of results * HIV-ve participants *VCT provided according to WHO guidelines	Any high risk behaviour, unprotected sex, STI symptoms	No	388	3 mths	*Borderline significant reduction in proportion reporting sex with a partner known or thought to be HIV+ *No reduction in proportion of participants reporting unprotected sex
Venkatesh et al 2011 (104)	*Nested cohort study in Zimbabwe & South Africa *Participants were women aged 18-49 sero-converting during an RCT between 2003-2006 on effectiveness of diaphragm & lubricant gel in preventing HIV acquisition *Analyses compared sexual behaviours reported at visits pre & post seroconversion	* HTC offered quarterly to all women as part of the RCT * Impacts of HTC assessed among women who sero-converted	Being sexually active, coital freq, condom use, >1 sex partner	No	327	12-24 mths	*Women less likely to report >4 sex acts in past wk, >1 sex partner or anal sex at visits post- compared to pre-seroconversion *Women more likely to report consistent condom use at visits post seroconversion *Weak evidence that women less likely to report being sexually active after seroconversion

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† Where outcome measures assessed at >1 follow-up, key findings reported for longest period of follow-up, unless stated otherwise

& Adjusted analysis found no impact among HIV+ve women, & that HIV-ve women increased bar attendance & # of partners in last month, but this was driven by modest changes among small # of women

Table 2.1 continued

Author & Ref	Setting and study design	Intervention & sero-status of participants	Outcome measures	Control grp	N*	Follow-up†	Key findings
Nuwaha et al 2012 (105)	*Pre-post analysis - serial cross sectional surveys in 2004 & 2007 among adults 18-49 yrs before & after implementation of home-based VCT in Bushenyi, Uganda	*Home based VCT *HIV-ve & HIV+ve participants (results not stratified by HIV status) *VCT offered to all adults & children at risk of HIV (mother infected or dead) within all households in Bushenyi district over 2 yr period *Programme also provided community mobilisation & education in relation to HIV, and	Sex in past 12 mths, condom use, type of partners, reported STI symptoms	No	Baseline: n=1,402 Follow-up: n=1,562	Two x-sectional surveys at baseline & 24 mths	*Reduction in proportion of individuals paying or receiving money at last sex, reporting STI symptoms in past 12 mths *Increase in proportion of individuals using condom at last sex where money was exchanged *No change in proportion of individuals reporting any sex or sex with a non-regular partner in past 12 mths, or using condom use at last sex (any partner type)
Roth et al 2001 (106)	*Married or co-habiting sero-concordant or sero-discordant couples from prenatal or paediatric clinics in Kigali, Rwanda *Pre-post analysis in 1991-1992	*Couples PITC in antenatal or paediatric clinics *Sero-concordant (-ve or +ve) & sero-discordant couples *Men received additional risk-reduction counselling session designed to heighten awareness of HIV risk & illustrate safe sexual practices	Condom use	No	684 couples	12 mths	*Mean rates of protected sex increased among all couples except those who were concordant HIV-ve
Allen et al 2003 (107)	*HIV sero-discordant and sero-concordant HIV-ve cohabiting couples recruited in Zambia between 1994-1998. Women were aged ≤ 48 yrs, men were ≤ 65 yrs	*Couples VCT *Behaviour change following VCT assessed among sero-discordant couples *Same day VCT service including free treatment for syphilis, free condoms & condom skills training	Condom use	No	818 couples	3, 6, 9 & 12 mths	*Couples reported an increase in condom use after joint VCT (<3% of sex acts protected prior to VCT compared to >80% at 12 mth follow-up) *Biological markers corroborated this finding but also indicated at least half of all unprotected sexual contacts were not reported
Jones et al 2009 (108)	*HIV+ve sero-concordant or discordant couples aged 18+ recruited from VCT clinics in Zambia between 2003-2006 *Pre-post analysis	*Couples VCT *HIV+ve sero-concordant or sero-discordant couples *All women received 3 risk reduction counselling sessions after VCT. Men randomised to receive 1 or 3 additional risk-reduction counselling sessions	Condom use	No	83 couples	6 & 12 mths	*Significant increase in consistent male condom use in both study arms at 6 & 12 mth follow-up *Where male partner HIV-ve, increase in condom use greater among men receiving 3 risk-reduction counselling sessions vs those receiving 1
Farquhar et al 2004 (110)	*Pregnant women attending their first antenatal visit at a city council clinic in Kenya between 2001-2002 *Pre-post analysis	*PITC for pregnant women *HIV-ve & HIV+ve participants (some but not all results stratified by HIV status) *Women provided with information on testing, encouraged to inform partners about testing & to return within 7 days for individual or couples HTC	Condom use	No	871	2 wks	*Condom use increased from 14%-38% by 2 wk follow-up (p<0.001) *Among HIV+ve women, partner notification of status associated with significant increase in condom use *Couple counselling associated with increased condom use among HIV+ve but not HIV-ve women

*Number of individuals contributing to analysis of impact of HTC, unless stated otherwise

† Where outcome measures assessed at >1 follow-up, key findings reported for longest period of follow-up, unless stated otherwise

Table 2.1 continued

Author & Ref	Setting and study design	Intervention & sero-status of participants	Outcome measures	Contro l grp	N*	Follow-up†	Key findings
Desgrees-du-Lou et al 2009 (111)	*Pregnant women attending 7 antenatal clinics in Abidjan, Cote d'Ivoire between 2002-2003 *Pre-post analysis	*PITC for pregnant women *HIV-ve & HIV+ve participants (results stratified) *Partners were encouraged to come for testing	Condom use at sex resumption after delivery	No	710	18 mths	*Significant increases in proportions of HIV+ve & -ve women ever using condoms in 18 mths following HTC *Increases in consistent condom use were much lower (statistical significant not reported) *HTC associated with higher levels of communication with partners about sexual risks
Maman et al 2014 (109)	*RCT of enhanced PITC vs standard PITC among women recruited from ANC in South Africa between 2008-2010 *Participants were aged 18+ & had a primary partner for ≥6 months	*RCT of enhanced PITC vs standard PITC among pregnant women *HIV-ve & HIV+ve participants (results stratified) *Enhanced PITC included 15 min video priming women around decisions relating to HIV testing & risk reduction, enhanced pre & post-test counselling using interactive techniques (eg role plays), access to legal & support groups *Control women received standard PITC according to South African national guidelines	STI incidence, condom use	Yes	1,480	14 wks & 9 mths post-partum	*No effect of intervention on STI incidence among HIV+ve or HIV-ve women *Increase in consistent condom use among HIV-ve women at 9 mths post-partum. No effect among HIV+ve women, or among HIV-ve women at 14 wks post-partum
Kiene et al 2010 (112)	*Outpatients aged 18+ recruited from rural hospital in Uganda in 2008 *Participants were not tested for HIV in previous 3 mths, never tested HIV+ve, had sexual contact in last 6 mths *Pre-post analysis	*PITC at an outpatients clinic *HIV-ve & HIV+ve participants (results stratified) *Patients approached & asked whether wished to receive HTC. Rapid testing with same-day receipt of results & post-test counselling. Testing referral cards provided to encourage partner(s) to test	Unprotected sex with partner of unknown or sero-discordant status ('risky sex')	No	215	3 mths	*Non significant decrease in total number of risky sex acts among HIV+ve & -ve participants

*Number of individuals contributing to analysis of impact of HTC, unless stated otherwise

† Where outcome measures assessed at >1 follow-up, key findings reported for longest period of follow-up, unless stated otherwise

2.4.5 Summary of findings

The studies assessing the impacts of HTC on reported sexual risk behaviours and HIV incidence used different study designs and assessed different outcome measures at different periods of follow-up post-intervention, making it challenging to synthesize findings. However, in general, studies tended to show reductions in at least some sexual risk behaviours, particularly among HIV-positive individuals. Findings were mixed among HIV-negative individuals, with some studies reporting statistically significant findings and others not, although reassuringly studies generally did not find any increases in sexual risk behaviour associated with HTC use. The reported sexual behaviours most commonly investigated included condom use and numbers of sexual partners, while six studies measured HIV or STI incidence following HTC use.

Condom use

Twenty-one of 23 included studies assessed the impact of HTC on condom use behaviour (see Table 2.1). In total, two-thirds of these (14/21 studies) reported reductions in levels of unprotected sex or increases in condom use following HTC. However, in six studies this was restricted to situations where participants or their partners had tested HIV-positive (94, 102, 104, 106-108), while in two studies the measures of effect were stronger among individuals testing HIV-positive compared to those testing negative (96, 110). In addition, some studies reported increases in condom use with some but not all partner types (96, 105) or increases in reports of ever having used a condom but not of consistent condom use (111).

Numbers of sexual partners

Nine of 23 studies assessed the impact of HTC interventions on reported numbers of sexual partners. Two RCTs reported associations between HTC use and reductions in numbers of sexual partners 18 months (results not stratified by HIV-status) (98) or 36 months (HIV-positive participants only) (97) post intervention. However, evidence for an impact of HTC on numbers of sexual partners from observational studies was mixed. Four observational studies reported significant reductions in numbers of sexual partners, of which two were conducted among HIV-positive participants (94, 104), one included both negative and positive participants

(results not stratified by HIV status) (93) and one included HIV-negative participants only (95). Three other observational studies found no impacts of home-based VCT or self-reported prior VCT use on numbers of partners, with two of these including HIV-negative participants only (83, 99) and one being undertaken among positive or negative participants (results stratified by HIV status) (100).

Incidence of HIV or other STIs

In total six studies investigated the impact of HTC on the incidence of HIV or other STIs. One community cohort study among young people aged 15-24 in South Africa reported an association between HTC use and a reduction in HIV incidence (101). Two cluster RCTs found no overall impact of HTC on reductions in HIV incidence in Zimbabwe (although the study was not powered to detect a difference in HIV-incidence) (61), or among community members in South Africa, Tanzania and Zimbabwe (HIV-incidence was the primary outcome of this study) (97). However, the multi-country study did report reductions in HIV-incidence among the sub-group of women aged 25-32 (97). Two additional observational studies in Uganda and one RCT among pregnant women in South Africa found no impact of home-based or enhanced HTC on HIV (83, 99) or STI incidence (109), respectively.

2.4.6 Conclusions

Overall, the findings of the review suggest that HTC is associated with some sexual risk reduction among HIV-positive individuals. However, its impact among HIV-negative individuals is less clear, with a number of studies reporting no statistically significant reductions (or increases) in sexual risk behaviour among this group. The measurement of sexual risk behaviour is subject to recall and social desirability biases, and it is difficult to assess the extent to which this may have affected study findings, particularly given the nature of the intervention. Only a few studies reported measures taken to attempt to minimise social desirability bias, such as the use of confidential voting systems in Zimbabwe (100) or audio computer-assisted self-interviewing in one study in Zimbabwe and South Africa (104). A few studies included an assessment of the validity of the sexual behaviours reported, including correlation of reports made by different members of the same couple (96, 107) or the use of sexual diaries and biological markers (107). Encouragingly, these assessments generally corroborated the studies' findings. Many of the studies

reviewed were conducted in the early 2000s prior to the scale-up of ART, and those which recruited individuals at later time periods did not investigate whether changes in sexual risk behaviours might have persisted after the widespread availability of ART. Furthermore, of the 23 studies included, only six evaluated study outcomes one year or later post implementation of the intervention, and longer term studies would help in understanding whether any changes in sexual risk behaviour following HTC use can be sustained over time.

The findings from this review are largely in agreement with two previous meta-analyses which investigated the impacts of VCT on sexual risk behaviours in low and middle income countries and included data up to 2010 (22, 23). The first of these reported that participants were significantly more likely to report condom use after VCT (pooled random-effects OR: 1.69, 95% CI 1.25-2.31, $p < 0.01$), but that the significant effect was found primarily in studies which included HIV-positive individuals or sero-discordant couples (22). The second review found weak evidence for an overall positive impact of VCT on levels of condom use (pooled random-effects OR 1.39, 95% CI 0.97-1.99, $p = 0.08$). This effect was significant among HIV-positive individuals (pooled random-effects OR 3.24, 95% CI 2.29-4.58, $p < 0.001$), but could not be meta-analysed among HIV-negative individuals, as only one study provided results separately for HIV-negative participants (23). With regard to numbers of sexual partners, the first review found no overall impact of VCT on reductions in numbers of partners (pooled random-effects OR: 1.22, 95% CI 0.89-1.67, $p > 0.05$) (22), while the second review reported that VCT use was associated with a reduced likelihood of reporting an increased number of sexual partners (pooled random-effects OR 0.69, 95% CI 0.53-0.90, $p = 0.007$), but when stratified by HIV-status, this result remained significant only among HIV-positive individuals (23). Both reviews reported considerably heterogeneity in the studies included, with some articles reporting statistically significant findings and others not.

2.5 HTC and sexual behaviour change: qualitative perspectives

This section reviews theoretical frameworks for understanding processes of sexual behaviour change. It also synthesizes qualitative literature on clients' experiences of using HTC, and their perceptions of HIV prevention counselling messages from

studies undertaken in sub-Saharan Africa. Such studies may help to explain quantitative findings by shedding light on the processes which mediate sexual behaviour change.

2.5.1 Theoretical frameworks for understanding sexual behaviour change

Various theories have been proposed in an attempt to understand the underlying constructs of health behaviours, including models which focus on factors operating at the level of the individual, as well those which take account of broader structural or environmental determinants of behaviour (113, 114). Although individual level models of behaviour change have some key limitations in attempting to understand sexual behaviour change, primarily because they do not take account of socio-cultural or other environmental influences on behaviour (115, 116), HTC is in itself an intervention targeted at the level of the individual (or within the unit of a couple, where couple counselling is offered). As such, it seems appropriate to explore its role in HIV prevention within the framework of an individual level model of behaviour change.

Many individual level models of behaviour change such as the Health Belief Model, the Stages of Change Theory or the Theory of Reasoned Action were developed in Western settings, and are based primarily on psychological theory (113). The Health Belief Model (HBM) was originally developed by social psychologists at the United States Public Health Service in an attempt to understand the lack of public participation in health screening programmes (117). Since then the model has been adapted to explore various health behaviours including sexual risk behaviours and HIV transmission (118). The HBM incorporates four core constructs: perceived susceptibility to illness, perceived severity of illness, and perceived benefits and barriers to taking a particular course of action. The model also acknowledges that self-efficacy (belief in one's ability to change behaviour) and physiological or environmental cues also play a role in influencing behaviour (117).

The applicability of the HBM has been tested mainly in developed country settings (118), however some studies have assessed its relevance with regard to sexual risk

behaviour in developing countries. Studies in Benin (119) and Ghana (120) reported that the strongest HBM construct predicting condom use was perceived barriers, followed by perceived benefits, perceived susceptibility and self-efficacy. However, neither study explored the specific barriers which inhibited condom use, stated by Hounton *et al* simply as 'problems using condoms' (119). In another study testing the applicability of the HBM in Zimbabwe, external cues and the perceived support of friends and partners were found to be the most consistent factors associated with sexual risk reduction (121).

The Stages of Change Theory (SOC) was originally developed to assess smoking cessation behaviour (122). It consists of five stages along a behaviour change continuum including pre-contemplation, contemplation, preparation, action and maintenance. 'Decisional-balance' is central to this model, which assumes that individuals construct a 'balance sheet' of pros and cons in relation to performing a specific behaviour, and this helps to predict movement across the stages. The SOC theory has been most frequently evaluated in developed country settings (123-125). However, its individualistic and rather 'rational' approach doesn't take into account the dyadic and complex social context within which sexual behaviour occurs, particularly in African settings.

The Theory of Reasoned Action (TRA) proposes that intention is the strongest predictor of behaviour, and that intention is in turn influenced by individual attitudes (positive or negative feelings towards performing a specific behaviour) and subjective norms (beliefs regarding how other people view the behaviour, as well as how other people interpret one's own behaviour) (126). As with other models, individual agency is a core construct within the TRA, which assumes that behaviour is under volitional control and that beliefs about potential consequences help to predict behaviours. The model pays some attention to the influence of societal or external factors in the form of subjective norms, although the focus remains on individual willingness or unwillingness to conform to these. Van Landingham *et al* did a comparative analysis of the utility of the HBM and the TRA in predicting sexual behaviours among young men in Thailand (127). They found that the strongest predictor of consistent condom use was perceived peer norms about condoms and motivation to comply with these, and that the TRA better explained their findings when compared to the HBM. However, they also noted that the model did not take

account of other important social influences, such as group behaviours (visiting commercial sex establishments together with friends), and participants desire to partake in and conform to these.

Fishbein proposed an adapted version of the TRA which takes some account of external factors in the form of 'environmental constraints' (128). This integrated model, which draws on aspects of the HBM and social-cognitive theory, proposes that there are three primary determinants of behaviour including individual intention, the skills an individual possesses in order to perform the behaviour, and environmental constraints. Environmental constraints are not specifically defined, but might be taken to represent socio-cultural, socio-economic or other environmental factors which influence behaviour. The model further posits that intentions are influenced by individual attitudes, subjective norms and self-efficacy. Fishbein emphasizes that the relative importance of each of the constructs in this model will vary depending on the specific behaviour and population under consideration, and that as such the model is adaptable and relevant to a broad range of socio-cultural settings. However, few studies have assessed its utility in predicting sexual risk behaviours in African settings.

The individual-level models of behaviour change discussed above provide some potentially useful frameworks within which to assess the role of HTC in sexual behaviour change, although they generally place great emphasis on individual agency and the ability to enact behaviour change once the required knowledge, skills, attitudes and intentions have been acquired. While these concepts may apply in developed country settings, they may translate less well to African settings where individual agency is less prized and identity is linked strongly to cultural values and practices (115). In the context of HTC use in rural Tanzania, Fishbein's integrated model (128), which attempts to take some account of 'environmental' influences on behaviour, may prove most useful. As such, this model was used as a starting point to develop the conceptual framework which guided the qualitative analyses presented in Chapter 8 (Paper D).

2.5.2 Responses to HIV-prevention counselling messages among clients using HTC

Several studies have explored HIV-positive clients' perceptions of HIV prevention counselling messages (26-28, 129), however very few have focussed on the experiences of clients testing HIV-negative (130). Some studies among HIV-positive individuals have reported increased motivation to reduce sexual risk behaviour following HTC (28, 29, 131). In one study, reasons given for this included wishes to ensure children were not orphaned and were cared for, desires to protect partners from physical or psychological suffering, and a sense of moral obligation to prevent the spread of HIV infection (29). However, other studies have reported barriers to sexual risk reduction among HIV-positive individuals, including wishes to have children which were perceived as a barrier to condom use (27), or that sexual desires returned as ART led in improvements in health (26, 131). Many studies have reported preferences for sex without condoms, particularly among men (26, 28, 131), or that sex without condoms symbolised a committed and intimate partnership, and thus their use within marriage was difficult (26, 132). One study exploring responses to HIV prevention counselling messages among individuals testing HIV-negative found that most participants reported having changed or reduced their sexual risk behaviour prior to attending for VCT, and that counselling served to consolidate pre-test decisions about risk behaviour rather than to initiate them. This study also found that HIV-negative individuals reported a need for greater support in the period after testing, such as additional counselling and regular reminders to safeguard their negative status (130).

A number of studies have explored the issues surrounding HIV sero-status disclosure among individuals testing HIV-positive (129, 133, 134). Fears of stigma and discrimination, or of blame for bringing HIV into the relationship, act as barriers to disclosure among both men and women (129, 133, 134), while women also fear abuse or loss of economic support (135). However, some studies have reported positive outcomes after disclosure of HIV-positive status, for example that it led to increased support within the relationship, particularly with regard to accessing treatment (131). In another study among HIV-positive pregnant women in Tanzania, Kilewo et al reported that while almost half of women who did not disclose their sero-status feared that it might lead to divorce, nearly all women who did disclose their results reported that their relationship continued afterwards (136).

A few studies have reported that clients in sub-Saharan Africa may view the utility of HTC primarily as a diagnostic tool rather than an opportunity to discuss HIV-related risk (137, 138). In an early study exploring community perceptions of a VCT programme in rural Uganda, many participants felt that VCT did not lead to any changes in sexual risk behaviour or to increases in condom use, which were generally viewed in a negative light because they reduced sexual pleasure or broke easily (137). Nevertheless, participants expressed a need for VCT services and felt that they were useful because they gave clients better knowledge about HIV/AIDS and might lead to less stigmatisation of people living with HIV. A number of studies have highlighted that behaviour change processes are likely to be iterative, and that a single counselling session is unlikely to be sufficient in influencing behaviour (26, 137), suggesting a need for continued or ongoing counselling.

2.6 Conclusions

This chapter summarises the findings from studies that have assessed the uptake of HTC services in sub-Saharan Africa, as well as their impact in reducing sexual risk behaviour and HIV incidence, and clients' perceptions of HIV prevention counselling messages. While it is clear that there have been dramatic increases in the uptake of testing in the last ten to fifteen years, there is considerable heterogeneity in uptake between countries, and the relative success of different strategies in attracting different types of service users and in identifying HIV-positive individuals is less well understood. Furthermore, the impact of HTC on sexual behaviour change and HIV-incidence among HIV-negative individuals is unclear.

Community HIV cohort studies can play an important role in investigating the uptake and impact of HTC services as they provide information on HTC use and HIV status, as well as other socio-demographic and behavioural characteristics, over extended periods of time. As such, they can be used to document the characteristics associated with service use and provide estimates of coverage with HTC, as well as to investigate the potential impacts of HTC on sexual risk reduction, using both quantitative and qualitative methods.

3 Quantitative research methods

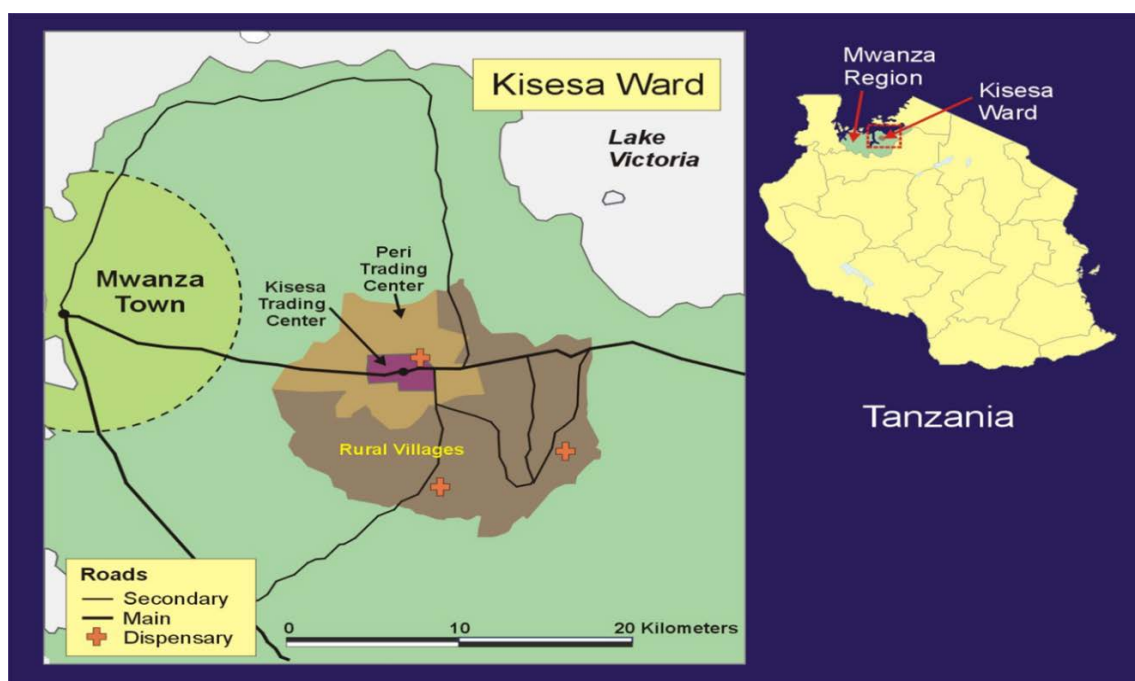
This chapter describes the research setting including the demographic surveillance activities, community HIV-cohort study and HIV services available in the study area. It also describes the methods of data management and preparation for primary and secondary data sources, and gives an overview of the statistical methods used in quantitative analyses.

3.1 Context

3.1.1 The research setting

Kisesa ward is an administrative unit within Magu district in Mwanza region, northwest Tanzania (Figure 3.1). It lies approximately 20 kilometres east of Mwanza city, the regional capital and Tanzania's second largest city, and includes seven villages, each of which is divided into a number of sub-villages. For the analyses presented in this thesis, sub-villages are categorised as being located in rural areas, along a main tarmac road which runs through the study area, or surrounding the study area's trading centre (Kisesa trading centre). The ward had a population of approximately 32,000 people in 2012, the majority of whom belong to the Sukuma tribe, Tanzania's largest ethnic group. The study area is predominantly rural in nature with economic activities revolving around small-scale farming and the petty trade of agricultural products such as milk, tomatoes, maize, fish and rice. Per capita income is low, estimated at approximately 340 US dollars per year in 2011 (139).

Figure 3.1 Location of Kisesa ward and study area



3.1.2 Kisesa cohort study activities

The primary research activities conducted as part of the Kisesa cohort study include ongoing rounds of biannual demographic surveillance (the demographic surveillance system or DSS), and serological surveys (sero-surveys) which are conducted once every two to three years. Each of these activities are described in detail below.

Demographic surveillance system (DSS)

The DSS constitutes a census of the entire population (i.e. including all children and adults) of the seven villages which make up Kisesa ward, with 28 rounds of the survey having been completed between 1994 and 2013 (see Figure 3.2). At each round all households in the study area (including any new households appearing since the last round of demographic surveillance) are visited by trained fieldworkers. A single individual (usually the head of household, or another well informed household member if the household head is not present) responds on behalf of all household members, reporting information on residence status of each individual (whether alive or dead, whether still living there or moved house within the study area, or out- migrated from the study area), any new or returning household members, spousal and parent-child links within households, pregnancy among

women of reproductive age, births, deaths and, since the fifteenth round of the DSS in 2003, number of years of schooling for those aged 5 to 25 (see Appendix 11.2.1 for an example of the household enumeration form used at DSS round 28 in 2013). Response rates during DSS rounds are generally very high ($\geq 98\%$; households are re-visited several times if nobody is present to respond at the initial visit). For the research presented in this thesis, data from DSS rounds 16 to 27 were linked to the sero-surveillance data (see below), and these data were used as the denominator in quantitative analyses.

Serological surveillance

In addition to the DSS, seven rounds of serological surveillance (sero-surveys) have been completed between 1994 and 2013 (in 1994-1995, 1996-1997, 1999-2000, 2003-2004, 2006-2007, 2010 and 2013; Seros 1 to 7, respectively, see Figure 3.2) as part of the Kisesa cohort study (data from sero-survey rounds 4, 5 and 6 are used as part of this thesis). Eligibility for sero-surveys is based on having been resident at the most recent round of demographic surveillance (for existing household members, having responded 'yes' to DSS question 'Still live here?', or for new or returning members of the household, classified as 'resident' – see DSS enumeration form in Appendix 11.2.1) and being aged 15-44 (Sero1), 15-46 (Sero2) or 15 or older (all subsequent rounds) at the time of the sero-survey. During sero-surveys, eligible individuals are invited to a central location within each village in order to participate. Transport to the sero-survey site is provided free of charge for all study participants. Separate consent is provided for each element of the study (i.e, participants may choose to participate in any single element of the study without being required to participate in other parts of the study), including completion of a structured interview questionnaire with a trained researcher, provision of a finger-prick blood sample for research HIV testing, and since Sero4 in 2003-2004, optional use of a voluntary mobile or community outreach HTC service. All study participants are also offered free medical treatment for any health problems present at the time of the sero-survey, for themselves and any accompanying family members.

During sero-surveys, study participation occurs in the following chronological order: registration, completion of the interview questionnaire, provision of a finger prick blood sample, visit to the study clinician or nurse for a medical consultation, and

participation in HTC. Each element of the study takes place in a separate purpose constructed hut or room (making use of existing village infrastructure where possible) in order to ensure privacy. Interview questionnaires are administered by trained, same sex researchers in Swahili or in the local language Sukuma if appropriate, and cover topics on family planning and sexual health, HIV and ART knowledge, partnerships, sexual behaviour and use of HIV and other health services (see Sero6 questionnaire provided as an example of a typical sero-survey questionnaire in Appendix 11.2.2). Data from the DSS can be linked to the sero-survey data using unique identifiers assigned to study participants, providing access to additional information on spousal links between those attending sero-surveys, recent changes in marital status, or periods of in and out-migration from the study area..

Research HIV testing during sero-surveys is anonymous and based on informed consent without results disclosure. During Sero1 whole blood was collected by venepuncture. From Sero2 onwards all samples were collected as dried blood spots on filter paper. HIV testing is performed at the regional reference laboratory at the National Institute for Medical Research (NIMR) in Mwanza city, with serologic diagnosis based on two ELISAs (Enzygnost HIV1/HIV2 (Behring, Marburg, Germany) and Vironostika HIV-MIXT (Organon, Boxtel, the Netherlands) for Seros 1-3, Enzygnost HIV1/HIV2 (Behring, Marburg, Germany) and Uniform 2 (BioMerieux, Boxtel, the Netherlands) for Seros 4-7). At all rounds blood samples with reactive results for both ELISAs were considered to be HIV positive, with Western blot tests used in the case of discordant results at Sero1, and repeat testing of samples using the two ELISA tests from Sero2 onwards.

Participation in sero-surveys has declined over time, from approximately 85% at Sero1 (5,642/6,672 of all those eligible participating) to 55% at Sero6 (6,511/11,946 of all those eligible participating). Table 3.1 below shows the distribution of participation in sero-survey rounds 1 to 6 by sex and age-group. Declines in participation have been greatest among men aged 25-54 living in roadside villages or in the trading centre (140), likely as a result of out-migration for work (the implications of declining participation for the study's results are considered in the thesis discussion).

Table 3.1: Distribution of participation in sero-survey rounds 1-6 by sex and age-group

	Sero1		Sero2		Sero3		Sero4		Sero5		Sero6*	
	Eligible	Attended (%)	Eligible	Attended (%)	Eligible	Attended (%)	Eligible	Attended (%)	Eligible	Attended (%)	Eligible	Attended (%)
Men												
15-24	1600	1328 (83.0)	1750	1371 (78.3)	1826	1204 (65.9)	2148	1593 (74.2)	2307	1629 (70.6)	2150	1084 (50.4)
25-34	979	806 (82.3)	1054	819 (77.7)	1093	702 (64.2)	1297	859 (66.2)	1241	658 (53.0)	1026	428 (41.7)
35-44	562	455 (81.0)	670	503 (75.1)	756	508 (67.2)	913	600 (65.7)	863	468 (54.2)	808	367 (45.4)
45-54	31	19 (61.3)	102	81 (79.4)	434	289 (66.6)	506	331 (65.4)	594	357 (60.1)	606	282 (46.5)
55+	2	0 (0)	7	3 (42.9)	527	375 (71.2)	639	481 (75.3)	643	442 (68.7)	688	364 (52.9)
Overall participation												
men	3174	2608 (82.2)	3583	2777 (77.5)	4636	3078 (66.4)	5503	3864 (70.2)	5648	3554 (62.9)	5278	2525 (47.8)
Women												
15-24	1584	1395 (88.1)	1720	1488 (86.5)	1751	1345 (76.8)	2206	1691 (76.7)	2336	1786 (76.5)	2089	1277 (61.1)
25-34	1223	1066 (87.2)	1338	1163 (86.9)	1474	1154 (78.3)	1695	1260 (74.3)	1714	1212 (70.7)	1561	924 (59.2)
35-44	669	561 (83.9)	804	682 (84.8)	953	736 (77.2)	1187	889 (74.9)	1150	777 (67.6)	1223	727 (59.4)
45-54	15	11 (73.3)	116	92 (79.3)	558	441 (79.0)	689	509 (73.9)	764	520 (68.1)	825	460 (55.8)
55+	7	1 (14.3)	11	5 (45.5)	672	516 (76.8)	798	579 (72.6)	909	684 (75.2)	970	598 (61.6)
Overall participation												
women	3498	3034 (86.7)	3989	3430 (86.0)	5408	4192 (77.5)	6575	4928 (75.0)	6873	4979 (72.4)	6668	3986 (59.8)
Overall participation												
men and women	6672	5642 (84.6)	7572	6207 (82.0)	10044	7270 (72.4)	12078	8792 (72.8)	12521	8533 (68.1)	11946	6511 (54.5)

*Note that all Sero6 figures are preliminary – the final breakdown of Sero6 participation by sex and age-group is not yet available, although the pattern is not expected to change significantly from the figures shown here.

3.1.3 HIV testing and counselling services during sero-survey rounds

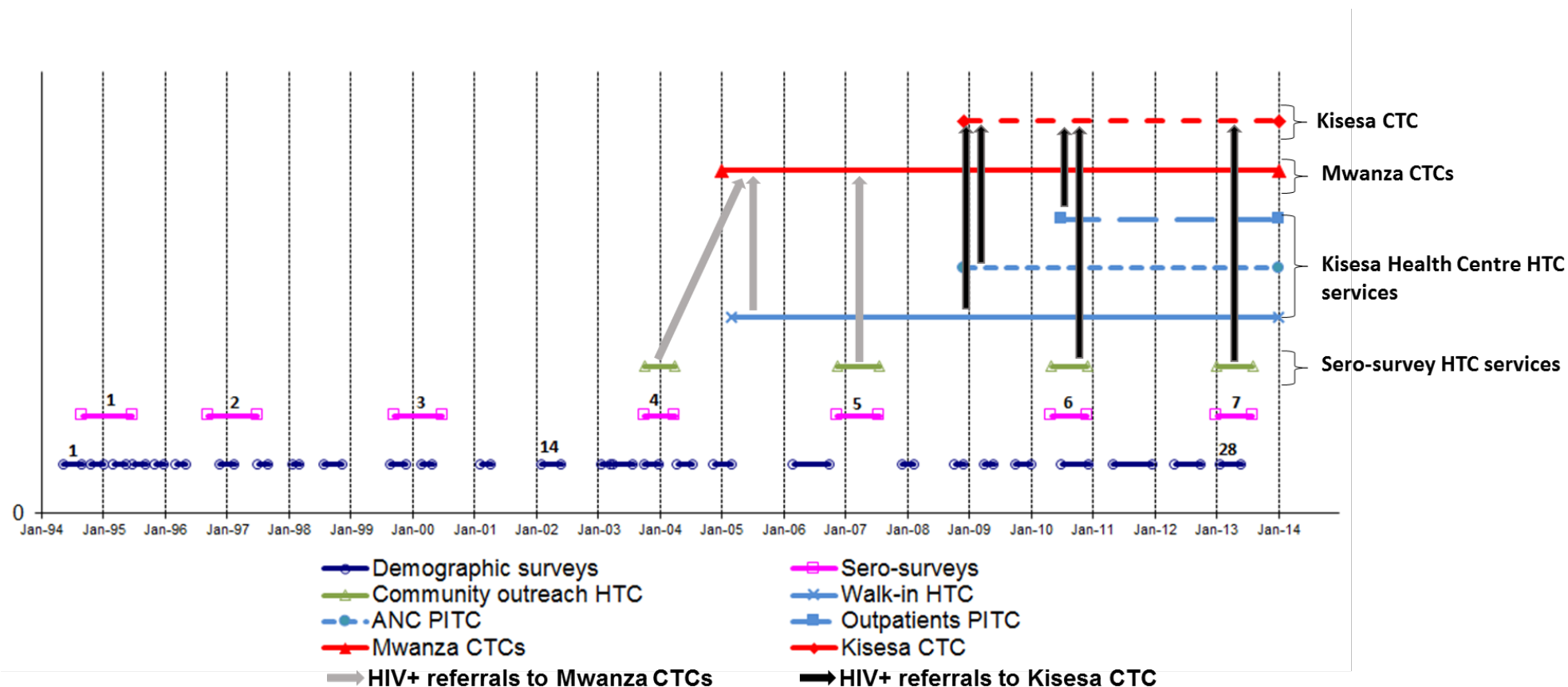
During Sero3 in 1999-2000, a voluntary HTC service was provided by a trained counsellor who followed the sero-survey team, however less than 1% of study participants used the service. Since Sero4 in 2003-2004, a mobile voluntary community outreach HTC (CO-HTC) clinic has been set up within pre-existing buildings or temporary purpose constructed huts within each village, and routinely offered to all study participants. The CO-HTC service is offered for the duration of the sero-survey - i.e. for approximately one month in each village. The clinic is located close to the main sero-survey site where interview questionnaires are completed. CO-HTC services are provided according to Tanzanian national VCT guidelines (6) by trained counsellors who come from outside the study area. However, some counsellors providing HTC services during sero-surveys also provide HTC at a walk-in clinic at the study area's main health centre (see Section 3.1.4 below). The study numbers of those using the CO-HTC service are anonymously linked to the main sero-survey questionnaire data using unique, numeric participant identifiers.

At Sero4, venous blood was collected from CO-HTC clients and transported to the NIMR laboratory in Mwanza for testing, with diagnosis based on two ELISAs as for research tests. Clients were asked to return for their test results and post-test counselling one week later, at the same location where testing had been performed. During Sero5 in 2006-2007 and Sero6 in 2010 venous blood was again collected but rapid HIV screening tests were used (preliminary test using Capillus, confirmatory test using Determine. If the preliminary test was positive and the confirmatory test was negative, the sample was sent for testing using two ELISAs as for research tests. Quality control was performed on a 5% sub-sample of rapid tests using two ELISAs as for research tests, at the NIMR laboratory in Mwanza). Where rapid HIV tests were used (i.e. from Sero5 onwards), results and post-test counselling were usually delivered to clients within 45 minutes of the test being performed.

During post-test counselling, clients with an HIV negative result were counselled about risk reduction and HIV prevention strategies, and encouraged to repeat HTC three months later for those potentially in the window period for infection, or otherwise at a later date in the future. Clients with a positive test result were advised on strategies to reduce the risk of onward transmission and on healthy living with

HIV. During Sero4 in 2003-2004, which was before free availability of ART in Tanzania, individuals testing HIV-positive were informed that treatment would become available in the near future through the Tanzanian national ART programme, which started at the end of 2004. With their prior agreement, these individuals were subsequently traced by the HTC counsellors and referred to an HIV care and treatment centre (CTC) at the zonal referral hospital (Bugando Medical Centre) in Mwanza city 20 kilometres away, which opened at the beginning of 2005. Individuals testing HIV-positive at Sero5 were referred for follow-up care at one of two Mwanza CTCs (either Bugando Medical Centre or Sekou Toure regional hospital), while those testing positive at Sero6 were referred directly to a local CTC which opened within the study area's health centre at the end of 2008 (see Figure 3.2).

Figure 3.2 Timeline of Kisesa cohort study activities and availability of HIV services in the study area



3.1.4 Other HIV testing and counselling services in the study area

The study population is served by a government-run health centre located in Kisesa trading centre - Kisesa Health Centre (see Figure 3.3). A voluntary walk-in HTC (WI-HTC) clinic opened at the health centre in March 2005, with services delivered free of charge and according to Tanzanian national guidelines (6), as during sero-surveys. The WI-HTC was initially based in NIMR field offices but subsequently transferred to a purpose-built clinic in June 2006. The WI-HTC includes two dedicated counselling rooms and a waiting room and is usually staffed by one or two trained counsellors dependant on financial resources, some of whom also provide the HTC services offered during sero-surveys. Rapid HIV tests are used to test finger-prick blood samples, with results usually available within 30-45 minutes of tests being performed (preliminary test using Capillus until April 2006, Bioline thereafter. Confirmatory test using Determine. A third discriminatory test (Unigold) is used in the case of discordant test results).

Between 2005 and 2008, clients testing HIV-positive at the WI-HTC clinic at Kisesa Health Centre were referred to CTCs at Mwanza city hospitals (Figure 3.2). Since the end of 2008, clients have been referred directly to the CTC located within the health centre. At this time, Kisesa residents already receiving HIV care at Mwanza city hospitals were given the option of transferring to Kisesa CTC if they were stable on ART and wished to do so. Services provided at Kisesa CTC include CD4 counts (since 2012) and prescriptions for opportunistic infections and ART, which is prescribed in accordance with Tanzanian national protocol, based on WHO guidelines.

Figure 3.3 Images of Kisesa Health Centre
(Images reproduced with permission from Annabelle Gourlay)



Top left: Kisesa Health Centre WI-HTC (labour and delivery ward in background). Top right: Kisesa CTC. Middle left: entrance to Kisesa WI-HTC. Middle right: WI-HTC waiting area. Bottom left: Counselling room. Bottom right: entrance to Kisesa CTC.

Since the roll out of a prevention of mother-to-child transmission (PMTCT) programme at Kisesa Health Centre at the end of 2008, provider-initiated testing and counselling (PITC) has been routinely offered to all pregnant women attending the health centre antenatal clinic (ANC) (Figure 3.2). Prior to this, smaller numbers of pregnant women were referred for antenatal HIV testing at the WI-HTC if they had symptoms suggestive of HIV infection, or if they requested to be tested. As part of the PMTCT programme, pre-test counselling usually takes place in a group rather than individual format, but delivery of test results and post-test counselling are conducted individually, in accordance with national guidelines (9). Pregnant women who do not wish to receive PITC may opt out, although in practice many women accept testing (141). While antenatal PITC is usually conducted at the ANC by trained nurse counsellors, women are sometimes referred to the WI-HTC, dependant on staffing and test kit availability at the ANC.

In theory PITC has been offered to patients attending out-patients clinics at Kisesa Health Centre since 2010, including a sexually transmitted infections clinic and a tuberculosis clinic. In practice the numbers of patients who have been offered these services are very small, with reported reasons for this including high patient volume resulting in lack of time to provide PITC, lack of training for clinical staff and inadequate HIV test kit supplies (Denna Michael, personal communication August 2014).

In addition to the services provided at the health centre, the population in Kisesa is served by three small dispensaries located in the rural villages of Igekemaja, Welamasonga and Ihayabuyaga. These provide basic outpatients and maternal and child health services. Since mid-2009 antenatal PITC is usually offered to pregnant women attending the rural dispensaries, dependant on the availability of test kit supplies, however HTC services for the general population are not available. Figure 3.4 and Figure 3.5 show the locations of the health facilities in Kisesa ward.

Figure 3.4 Map of Kisesa ward showing clinics and locations of households

Clinics in Isangijo, Kanyama and Kitumba are only available temporarily during sero-survey rounds. (Map reproduced with permission from Jocelyn Poppinchalk).

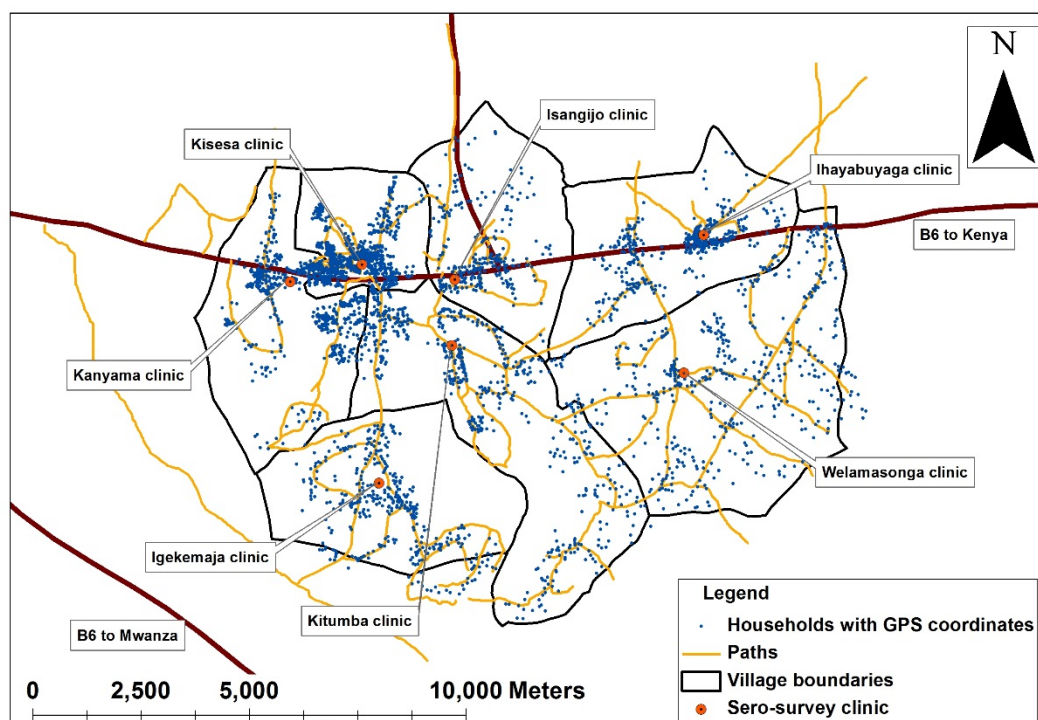
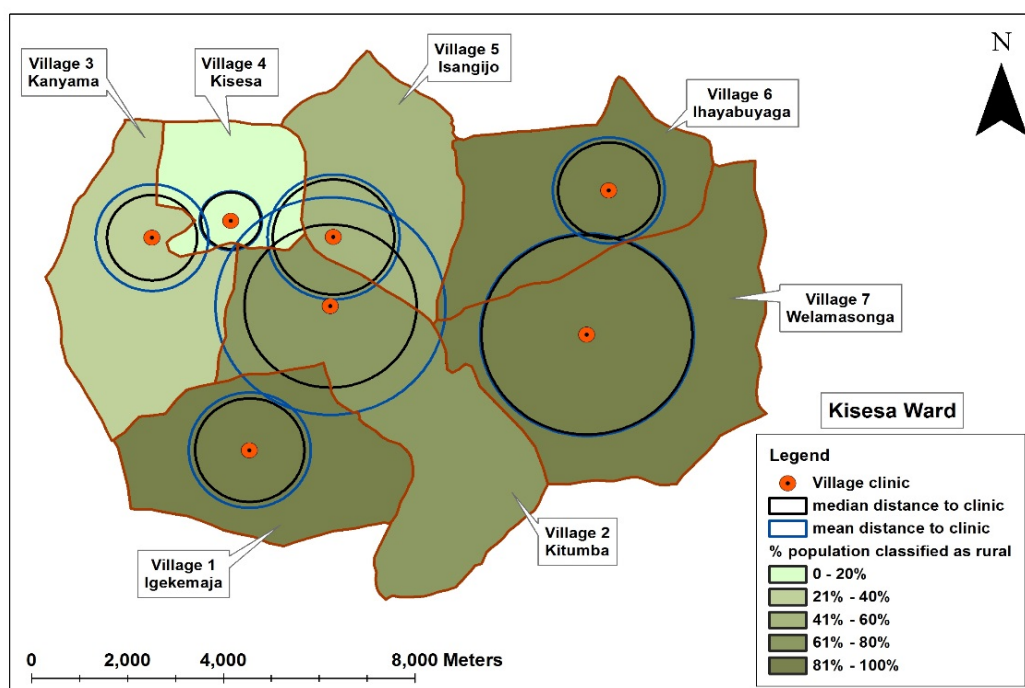


Figure 3.5 Map of Kisesa ward showing mean distances to sero-survey clinics and percentage of population classified as rural.

(Map reproduced with permission from Jocelyn Poppinchalk).



3.1.5 HIV prevention activities and support for HIV-positive persons in Kisesa ward

Since the start of the Kisesa cohort study in 1994, various HIV prevention activities linked to district level HIV prevention programmes have been implemented (142). These include the establishment of village AIDS committees, school interventions and education campaigns to reduce high-risk sexual behaviour, and the provision of periodic outreach testing campaigns within villages or at community events, e.g. on World AIDS Day.

Between 2005 and 2008, a community-based organisation, TUMAINI, provided home-based care and related support services to HIV-positive persons in several wards in Mwanza Region, including Kisesa. A community volunteer was usually available to escort clients testing HIV-positive to CTC sites in Mwanza city for their first appointment, and to act as a treatment support partner for some clients. The TAZAMA project also provided a transportation allowance for HIV-positive patients travelling to attend appointments at CTC sites in Mwanza city (2,000 Tanzanian shillings or approximately £0.80 per appointment), until the CTC opened at Kisesa Health Centre at the end of 2008, when patients could access services locally.

3.2 Data entry and management

3.2.1 Demographic surveillance system and sero-survey data (secondary datasets)

Demographic surveillance system and sero-survey data were double-entered using CSPro 4.0 (143). Geographic identifiers were constructed for participants of the demographic surveys based on their current place of residence, and linked to unique study numbers assigned to sero-survey participants. Data on HIV research tests and CO-HTC attendance were anonymously linked to sero-survey data using unique participant identifiers.

Data on socio-demographic characteristics collected during sero-surveys included sex, date of birth, ethnicity, religion, marital status, income generating activities performed and level of education. Sexual behaviour variables included age at first sex, numbers and types of sexual partners and condom use with different partner

types (see Sero6 questionnaire in Appendix 11.2.2). Information on marital status was also collected during recent DSS rounds allowing for the construction of marital status change variables, which represented marital status at the DSS round preceding a sero-survey compared to marital status reported at the sero-survey. The unique identifiers of spouses were also recorded during DSS rounds; these could be linked to sero-survey data to anonymously identify spousal HIV and HTC use status at each round. Sero-survey questionnaires also captured information on participants' previous use of HTC services within or outside the study area. Further details relating to preparation of data for the analyses presented in this thesis can be found in each of the individual results chapters.

3.2.2 Newly collected data (primary datasets)

A major component of the analyses presented in Chapter 4 (Paper A) involved the entry and linkage of data from the WI-HTC clinic at Kisesa Health Centre to the cohort study datasets. Few research sites in Africa have implemented systems to link population-level data from DSS sites to health facility datasets. Methods for retrospective record linkage (i.e. after the time point of clinic access) are still in development but are largely based on matching records on personal attribute data that are common to both datasets (e.g. name, date of birth, sex, residence information) (144). However, records corresponding to the same individual rarely match exactly on these identifiers, due to spelling errors, use of nicknames, masking of real names, change in last name after marriage, interchanging middle and last names, poor recall of date of birth, or change in place of residence. The procedure for matching records must therefore employ a probabilistic approach whereby match-scores are calculated which represent a measure of the similarity between individual identifiers in each of the two datasets (the alternative deterministic approach relies on an exact match on personal attributes, or a unique identifier between datasets). Weights, representing the relative importance of a match on each individual identifier (in terms of maximising the sensitivity and specificity of matching) are then applied and used to generate an overall match score for each pair of records.

The aim of the record linkage work between the WI-HTC clinic data and the Kisesa cohort study dataset was to automate the matching procedure given the large volume of records (in the order of 30,000 DSS records and 18,000 WI-HTC clinic

records), and to make the process as reproducible and objective as possible. The process of preparing the datasets for linkage and implementing the linkage algorithm consisted of several steps including: i) Entry and cleaning of the WI-HTC clinic data; ii) Creating a gold standard dataset and designing a scoring and weighting scheme (the linkage algorithm) which could be used to match the clinic and DSS records using Structured Query Language (SQL) iii) Testing the linkage algorithm developed to ensure it was running correctly, which involved viewing the results of the matching and then refining the algorithm and re-processing the matches (numerous iterations); iv) Validating the final match set produced by the linkage algorithm, including resolving cases of multiple matches (multiple DSS records chosen as a match for one clinic record and vice versa). The scoring scheme for the linkage algorithm was initially designed by a senior data manager based at NIMR Mwanza (Benjamin Clark), however, I was involved in various stages of model development. These steps and my role in each of them are described in further detail below.

3.2.3 Entry and cleaning of data from the WI-HTC clinic

Since July 2009, two TAZAMA-designed registration books have been completed by counsellors at the WI-HTC clinic (in addition to the standardised government logbooks which have been used at the clinic since it opened in 2005. Counsellors receive a monthly salary supplement from the TAZAMA Project in order to complete the TAZAMA registration books, as well as for completion of TAZAMA-designed referral forms which are used to monitor access to CTC services among HIV-positive individuals). The first TAZAMA WI-HTC (or VCT) registration book includes a unique numerical identifier (ID) which is assigned for each test visit, information on personal identifiers (client name, age, sex, village of residence) and data on a number of socio-demographic variables (marital status, occupation, religion, level of education), with standardised codes used to categorise data (see registration book template in Appendix 11.2.3). In the case of repeat testing visits at the WI-HTC, counsellors attempt to record the unique ID number corresponding to a client's first test visit in a second identifier field, as a means to link repeat visits by the same client together. However, this is dependent upon the client presenting a test card which contains the ID number corresponding to his or her first visit (see client ID card template in Appendix 11.2.4), or by the counsellor tracing back through the registration books to find the entry corresponding to the reported date of the first visit, if no ID card is presented. This system is unlikely to capture all repeat visits

made by individual clients at the WI-HTC, although the extent of missed repeat visits is unknown.

HIV test results are entered into a second book, for which a standard template has not yet been designed and rule-lined 'counter' books are used (see Appendix 11.2.5). This book contains fields for the VCT client ID number (referred to as 'sample number' in older versions of the tests results books (up to June 2009). The unique test visit ID number should be entered into this field, but sometimes the repeat test visit ID is used), test date and rapid test results.

Data from the main WI-HTC registration books covering the periods March 2005-June 2009 (government logbook data) and July 2009-June 2010 (TAZAMA registration books) had already been entered as two separate datasets. I undertook further work to coordinate entry of the TAZAMA registration books covering the period July 2010-November 2012, and to merge all the WI-HTC main registration data together to obtain one master dataset. The entry of the TAZAMA registration books covering the period July 2010-November 2012 involved the creation of a new CS-Pro data entry tool in order to standardise WI-HTC data entry with other data entry systems used by the TAZAMA Project, and was managed by a senior clinic data manager based at NIMR Mwanza (Clemens Masesa). I oversaw the data entry process and provided administrative and technical support, identifying the relevant logbooks for data entry, developing the edit checks, and advising on initial data cleaning procedures. I carried out further extensive cleaning on the merged WI-HTC data, relating particularly to issues around client ID numbers (unexpected duplicates within the field which should have contained a unique ID number for each test visit (this sometimes represented the same client and sometimes different clients). Erroneous duplicates where the second ID number recorded against repeat testing visits actually represented different clients). I also coordinated the entry of all the HIV test results books, none of which had been entered before, including advising on the creation of CS-Pro data entry screens, edit checks and data cleaning procedures. I subsequently linked these test result data to the main WI-HTC registration books.

Linkage between the main WI-HTC registration data and the test results books was achieved using the unique test visit ID number (where this had been recorded in the test results book), or otherwise a combination of the repeat client ID number and date (where the repeat client ID number was recorded in test results book), or a combination of repeat client ID number, date, age and sex (where there were erroneous duplicates on repeat client ID number and date (clients cannot test more than once on the same day; these records represented more than one individual)) (see Table 3.2). I also manually reviewed approximately 2,600 records in the main WI-HTC registration data for which no matching test result could be found. These steps resulted in a matching test result being found for 81.7% (14,514/17,775) of the main registration data (Table 3.2), while for the remaining 18.3% (3,261/17,775) no matching test results were found.

Table 3.2 Steps taken to match test results to WI-HTC clinic main registration data

Variables or methodology used to match records	Number (%) of WI-HTC main registration records for which a matching test result was found
Unique test visit client ID number	11,558/17,785 (65.0%)
Repeat client ID number, date	1,258/17,785 (7.1%)
Repeat client ID number, date, age and sex	1,343/17,785 (7.6%)
Manual review of remaining unmatched main registration and test result data	355/17,785 (2.0%)
Total number (%) of main registration records matched	14,514/17,775 (81.7%)

3.2.4 Linkage of records from the WI-HTC clinic to the cohort datasets

Creation of a gold standard dataset and development of the linkage algorithm

The gold standard dataset was developed by the senior data manager manager based at NIMR Mwanza and contained known or deterministic links (i.e. based on a unique identifier) between those who used the CO-HTC service provided during Sero6 and their corresponding cohort record, and also contained the same set of personal identifiers reported in each dataset (i.e. in the main sero-survey questionnaire and in the HTC register). There were 3,718 record pairs in the gold standard dataset, 338 of which were true matches. The remaining 3,380 records in

the gold standard dataset represented intentionally mismatched pairs, which included the top ten closest (in terms of total score) non-matches from the cohort data for each CO-HTC user. The intentionally mismatched pairs were chosen in order to train the linkage algorithm to distinguish between true matches and other similar high-scoring records which were not correct matches. The gold standard data were used to train and develop a scoring scheme and weights to be used by the linkage algorithm, using the solver tool in Microsoft Excel. In consultation with the data manager, I reviewed the output of several iterations of the scoring and weighting scheme in order to maximise the sensitivity and specificity of the linkage algorithm. This involved plotting the ranges of scores obtained for true-matches, true non-matches and mis-matches (false positives, false negatives) for each of the matching variables, and tweaking the match-scores and weighting schemes used in order to try and pull apart, as far as was possible, the distributions of scores for true matches and true non-matches. Details of the final scoring scheme that was used and the weights applied by the linkage algorithm applied are provided in Appendix 11.3.

I undertook a similar process of review and feedback of the linked datasets that were produced by the data manager after running the linkage algorithm in SQL. I helped to scrutinize the performance of the algorithms, including assessing the total number of linkages made (linkage rate) and number of DSS records matched to each clinic ID, and alerted the data manager to any possible errors in the code that were preventing the algorithms from running correctly. After dropping erroneous repeating HTC client IDs which represented different individuals, the final linked dataset outputted by the algorithm contained a total of 10,289 HTC clinic IDs which had been linked to at least one DSS record. This represented an overall linkage rate of 93.6% (10,289 of 10,994 Kisesa resident clients covering the period March 2005-November 2012). However there were a number of issues to resolve including large numbers of potential DSS matches for each clinic ID, and cases where the same DSS record had been matched to more than one clinic ID.

Validating the match set produced by the linkage algorithm

I carried out all of the validation steps described here. The vast majority of clinic ids (10,146/10,289 or 98.6%) had more than one potential DSS match in the final

dataset produced by the linkage algorithm. Many of the multiple matches would likely reflect the same individual who had moved residence within the study area and been assigned a different DSS identifier in the new household. However, for some records, particularly those with very large numbers of low-scoring multiple matches, there was likely to be a considerable number of false positives. A series of steps was therefore implemented in order to reduce the number of potential matches for each clinic record and select the best match. These steps are described briefly below and in detail in Table 3.3.

First, residency episode and event data were merged in from the DSS in order to drop match-pairs where the matched DSS individual was last seen in the study area before 2004 (more than a year before WI-HTC clinic opened in March 2005), or where the matched DSS individual was reported as having died before the date of the clinic visit. Next, a distance variable was created which represented the closest overlap (in number of days) between periods of residency in the study area and clinic visit dates (zero where the clinic visit overlapped exactly with a period of residence in the study area, otherwise the number of days between the clinic visit and date of entry into the study area (if clinic visit date before date of entry) or date of exit from the study area (if clinic visit date after date of exit)). Cases of multiple DSS matches per clinic ID were dropped by keeping a single top-scoring DSS match for each clinic record. If match-pairs were tied on top-score, the DSS record with the closest distance between the clinic visit date and period of residency in the study area was chosen. For a small proportion of records which were tied on both top-score and distance, the best match was selected at random.

The resulting one to one linked dataset (one DSS match per clinic record) contained cases where the same DSS individual had been chosen as a top-scoring match for more than one clinic ID number. It was possible that different clinic ID numbers represented the same person, if counsellors were not always successful in recording the original unique test visit ID number against new ID numbers for those with return or repeat visits. Alternatively, the different clinic ID numbers may have represented different people, with the requirement that just one be chosen as the best match for the DSS record. Due to the large volume of cases in which one DSS record had been linked to more than one clinic ID (4,824/10,264 or 47% of all records in the one to one linked dataset), it was not feasible to manually review records to attempt to

identify whether different clinic IDs linked to the same DSS number represented one or more than one person. For these cases, a single best clinic ID-DSS match pair was kept, using the same approach as described above for eliminating multiple DSS matches per clinic ID (top-scoring match pair kept. Match-pair with closest distance between clinic visit and period of residency in the study area chosen if records were tied on top-score, or selected at random for a small proportion of records which were tied on both top-score and distance variable).

Table 3.3 Detailed description of steps taken to validate the final match-set outputted by the HTC clinic-to-cohort linkage algorithm

	Validation step	Overall linkage rate (% of Kisesa resident HTC clients retained)	Number (%) of linked HTC client IDs retained at each step	Number of linked clinic-DSS record pairs retained
0	Full linked dataset containing all HTC client IDs between March 2005-November 2012 which were matched by the algorithm to the cohort dataset (n=10,289), and all potential DSS matches for each WI-HTC client ID (n=2,140,196 record pairs).	10,289/ 10,994 (93.6 %)	10,289/ 10,289 (100%)	2,140,196/ 2,140,196
1	Merged DSS residency episode data into linked dataset. (i) Dropped record pairs where matched DSS individual last seen in the study area before 2004 (more than a year before the WI-HTC opened). (ii) Dropped record pairs where matched DSS individual reported as having died before date of HTC visit, with buffer of six months around date of death in order to account for reporting inaccuracies. Where client had >1 HTC visit, date of most recent visit used to complete check for this and subsequent steps.	10,264/ 10,994 (93.4%)	10,264/ 10,289 (99.8%)	1,688,608/ 2,140,196
2	Created a one to one linked dataset: chose a single best DSS match for each individual HTC client ID. (i) Created a 'distance' variable representing closest overlap between periods of residency in the study area and HTC visit date. Distance is zero where HTC visit date falls within a period of residency in the study area – i.e. after date of entry into study area and before date of exit from study area. Where clinic visit date falls outside a period of residency, distance represents number of days between HTC visit date and date of entry into study area (if HTC visit date before date of entry) or number of days between HTC visit date and date of exit from study area (if HTC visit date after date of exit). (ii) Eliminated multiple DSS matches per HTC clinic ID by keeping top-scoring DSS match for each clinic ID. Where top-scoring DSS match was tied, kept the match with smallest 'distance' between HTC visit date and closest period of residency in the study area. Where DSS matches tied on top score AND closest distance, best DSS match selected at random. Dataset now contained one DSS match per HTC clinic ID.	10,264/ 10,994 (93.4%)	10,264/ 10,289 (99.8%)	10,264/ 2,140,196

	Validation step	Overall linkage rate (% of Kisesa resident HTC clients retained)	Number (%) of linked HTC client IDs retained at each step	Number of linked clinic-DSS record pairs retained
3	<p>Resolved cases where same DSS individual matched to more than one HTC clinic ID.</p> <p>(i) It was possible that different clinic ID numbers represented the same person, if counsellors were not successful in recording original unique test visit ID numbers against new test visit ID numbers for those with repeat visits.</p> <p>(ii) Alternatively, the different test visit ID numbers represented different people, and one had to be chosen as the best match for the DSS record.</p> <p>Without performing a manual review, it was not possible to determine whether cases fell into scenario (i) or (ii) above. Due to the large volume of cases involved (47.0% of all record pairs), only one HTC clinic ID-DSS match pair was kept for cases where the same DSS individual had been matched to more than one clinic ID. Same procedure used for selection of best clinic ID-DSS match pair to keep as described in step 2 above (top scoring match pair was kept. Where match-pairs tied on top score, pair with closest residency episode overlap was kept. Where match-pairs tied on top-score AND residency episode overlap, best match-pair kept at random).</p>	6,927/ 10,994 (63.0%)	6,927/ 10,289 (67.3%)	6,927/ 2,140,196
4	Manual review of every 100 th match-pair, sorted in order of descending match-score. This revealed a score threshold below which the validity or accuracy of match-pairs was in doubt, and so records below this threshold were dropped. The final linked dataset contained 4,046 HTC clients linked to a DSS record (1,955 (48.3%) of whom were sero-survey attendees).	4,046/ 10,994 (36.8%)	4,046/ 10,289 (39.3%)	4,046/ 2,140,196

After de-duplication the linked dataset contained 6,927 unique clinic IDs linked to one DSS record. This dataset was sorted in descending match-score order and clerical review of every 100th record-pair was undertaken. The review revealed a total match-score below which the validity or accuracy of the match-pairs was in doubt, and so records below this threshold were dropped. The final linked dataset available for analyses contained 4,046 unique clinic IDs which had been linked to a DSS participant, representing a linkage rate of 36.8% (4,406 of 10,994 Kisesa resident clients contained within the HTC clinic dataset covering the period March 2005-November 2012). Of the 4,046 HTC clients linked to a DSS record, 1,955 (48.3%) were sero-survey attendees.

The final linked dataset had low sensitivity, estimated at 17.8% based on the proportion of correctly matched gold standard links contained within the dataset, but a positive predictive value (PPV) of 68.9%. At the expense of further loss in sensitivity, the PPV could be increased to 78.5% and 85.0% by placing additional restrictions on the parameters for final match-pairs accepted. These restrictions included i) accepting match-pairs only where the distance or overlap between the clinic visit date and the closest period of residency in the study area was not greater than one year (PPV 78.5%), or applying this restriction and also only accepting match-pairs where the match-score for sub-village was at least 0.4 or higher (score range 0 to 1. Sub-village was found to be a good discriminator between true-matches and true non-matches in the gold standard data. PPV 85.0%).

3.3 Statistical analyses

All statistical analyses were conducted in Stata 12 (StataCorp, Texas, USA). All statistical tests used were two-tailed and interpreted at the 5% significance level.

For the analyses which looked at the uptake of HTC services (either CO-HTC use during sero-surveys, or clients testing at the WI-HTC or via ANC-HTC), explanatory variables were prepared using questions from the sero-surveys and linked information from the DSS. HIV status was based on sero-survey research test results. Socio-demographic, behavioural and clinical risk factors for service use were investigated separately by sex using *a priori* hypotheses, drawing on factors

identified in the literature or associated with access to other HIV services in Kisumu (42, 43). Data were first analysed using cross tabulations and chi square tests to explore associations between exposure variables and HTC use. Logistic regression models were used to compare the characteristics of those who tested and didn't test in crude and adjusted analyses. Multivariable models were fitted using a forward-stepwise approach and including all variables significant in univariable analyses at the $p \leq 0.10$ level. Likelihood ratio tests were used to assess the inclusion of variables in multivariable models (variable retained if it significantly improved model fit at the $p \leq 0.10$ level). Interactions were explored between HIV status and other characteristics found to be strongly associated with HTC use in this setting (area of residence, level of education and previous HTC use), and retained where statistically significant.

The denominator for analyses which explored CO-HTC use during sero-survey rounds included all sero-survey attendees. For the analysis of risk factors for WI-HTC and ANC-HTC uptake using the linked clinic-cohort dataset, some cohort participants were initially matched to a WI-HTC or ANC-HTC clinic record but then dropped during the validation procedures which created the final linked dataset. The analyses assessing risk factors for WI-HTC and ANC-HTC use among sero-survey attendees therefore used case-control methods, because the dataset did not contain the full denominator of all sero-survey attendees. For WI-HTC use, cases were defined as Sero6 attendees who were linked to a WI-HTC client with a clinic visit occurring within two years *after* participation in Sero6 (Sero6 was in 2010 and WI-HTC clinic data were available up to 2012. Given the potential for reverse causality, as sexual behaviours are hypothesized to change as a result of attending HTC, explanatory variables from the sero-survey and DSS were taken as measured *prior* to the time of HTC service use. Only clinic visits occurring up to three years after participation in a sero-survey were considered, in order to ensure that data had been recently collected). Controls were defined as Sero6 participants who were not linked to any WI-HTC clinic record.

For the analysis of risk factors associated with ANC-HTC use, women attending either Sero5 or Sero6 were included in order to increase sample size. Cases were defined as either i) women who participated in Sero5, reported a pregnancy between 2007-2010 and were linked to an ANC-HTC client with a testing visit within

three years of Sero5, or ii) women who participated in Sero6, reported a pregnancy between 2010-2012 and were linked to an ANC-HTC client with a testing visit within two years of Sero6. Controls were women who participated in either Sero5 or Sero6, reported a pregnancy between 2007-2010 (Sero5 attendees) or 2010-2012 (Sero6 attendees) and were not linked to any ANC-HTC clinic record.

Trends in coverage, i.e. the proportion of persons repeat testing or testing at different service types, were assessed using data on known HTC use (i.e. linked CO-HTC or clinic based HTC use) or on reported HTC use as indicated in responses to sero-survey questionnaires. The analyses which investigated risk factors for repeat testing relied on known CO-HTC use during sero-surveys, due to variability in completeness of reporting of previous HTC use during sero-surveys, and in identification of repeat testers at the clinic HTC services.

For the analysis which explored the impact of CO-HTC use on sexual behaviour change, nine indices of behaviour change were created by comparing sexual behaviours reported at one sero-survey round to those reported at the next. In order to explore any potential differences over time, analyses were carried out separately for those a) attending both Sero4 and Sero5 and using the CO-HTC service at Sero4, b) attending both Sero5 and Sero6 and using the CO-HTC service at Sero5. Multinomial logistic regression was used to assess associations between HTC use and three outcomes: an increase, decrease or no change in sexual risk behaviour, stratified by HIV-status. Crude associations were adjusted for potentially confounding socio-demographic variables (age, sex, marital status, area of residence, level of education and reported previous HTC use) in multivariable analyses. Poisson regression models were used to calculate crude and adjusted HIV incidence rates comparing those who used and didn't use CO-HTC.

3.4 Ethical considerations

3.4.1 Cohort study activities

Ethical approval for successive rounds of demographic and serological surveillance has been granted by the Tanzanian Medical Research Coordinating Committee (MRCC) and the Ethics Committee of the London School of Hygiene and Tropical

Medicine (LSHTM) (see ethical clearance certificates in Appendix 11.1.1). During the first four sero-survey rounds, verbal consent was obtained directly from all participants (including those aged less than 18) due to low literacy rates among the study population. Consent was witnessed and documented for each participant on their survey questionnaire, by a member of the sero-survey team. During Sero5 in 2006-2007 and Sero6 in 2010, consent was again obtained directly from all study participants including those aged less than 18, however the option of written consent was introduced for those who were able to provide it. During Sero7 in 2013 (data not included as part of this thesis) additional written consent was obtained from parents or guardians of participants aged less than 18.

During sero-survey rounds, temporary field sites are constructed at central locations within each village, with purpose constructed huts or private rooms ensuring confidentiality during questionnaire interviews and medical consultations. Research HIV testing is based on informed consent without results disclosure. However, the benefits of knowing HIV status are set out in the informed consent procedure, and CO-HTC services have been systematically offered to all participants at a confidential site near to, but separate from, the main sero-survey site since Sero4 in 2003-2004 (following the announcement of government plans to make ART available through a national treatment programme). Community opinion has indicated that if receipt of test results were made a condition of participation in sero-surveys, participation rates would be expected to fall markedly. In addition, it has indicated that people who had previously tested and were already aware that they were infected would be unlikely to participate in further surveys if this involved another round of counselling, leading to under-estimation of prevalence based on research tests, and very little information from people living with HIV/AIDS in the behaviour survey.

3.4.2 Linkage of clinic and cohort study datasets

Ethical approval for the entry of the WI-HTC clinic data and subsequent linkage to the cohort datasets was initially sought from the Tanzanian MRCC and the ethics committee of the LSHTM in 2010. Two amendments to these applications were submitted in February 2012 and November 2013 in order to cover work on an additional project using PMTCT data, and on a development phase of the linkage

algorithm. Approval for these amendments was granted by the ethics committee of the LSHTM in January 2014 and by the MRCC in April 2014 (see Appendix 11.1.2).

All data entry systems for the WI-HTC data were developed and stored on secure servers at NIMR Mwanza, while HTC logbooks were retained securely in a locked office at NIMR before being returned to the WI-HTC clinic. Client names were encrypted during the data entry process such that they were only seen by data entry clerks, who underwent ethical training. The resolution of discrepancies in client ID numbers in the merged WI-HTC dataset and the development of the linkage algorithm necessitated viewing of names and other personal identifiers in the gold standard and interim linked HTC datasets. All researchers and data managers involved in this process, including myself, participated in ethical training. The gold standard and interim linked datasets containing names were stored on secure servers at NIMR Mwanza (primarily), LSHTM, and on my personal laptop, all with password restricted access. Prior to using the linked results for statistical analyses, all personal identifying information, including names, were stripped from the datasets, leaving only numerical scores and ID numbers.

4 Paper A. Risk factors for service use and trends in coverage of different HIV testing and counselling models in northwest Tanzania between 2003 and 2010

Introduction to the paper

As modes for HTC service provision diversify, there is a need to understand which testing modalities are most effective at identifying HIV-positive individuals and those most at risk of infection, as well as whether different models of service provision help to increase the uptake of HTC among different socio-demographic groups. A small number of studies have compared the basic socio-demographic characteristics of individuals testing at community outreach or health facility-based HTC services (76-79), however few have explored the sexual risk profiles of individuals using different types of services (76), and only one study in Tanzania has explored the uptake of different types of HTC (a comparison of uptake of opt-out versus opt-in VCT among young people) (145). Paper A (submitted to Tropical Medicine and International Health) makes use of the linked clinic-cohort dataset containing information on usage of three different types of HTC services in Kisesa (community outreach HTC, walk-in HTC at the Kisesa Health Centre and antenatal testing of pregnant women) to explore the socio-demographic, behavioural and clinical characteristics associated with service use, as well as trends in coverage of different types of HTC services by gender, age-group and area of residence.

RESEARCH PAPER COVER SHEET

PLEASE NOTE THAT A COVER SHEET MUST BE COMPLETED FOR EACH RESEARCH PAPER INCLUDED IN A THESIS.

SECTION A – Student Details

Student	Caoimhe Cawley
Principal Supervisor	Alison Wringe
Thesis Title	Understanding the role of HIV testing and counselling services in HIV prevention in rural Tanzania

If the Research Paper has previously been published please complete Section B, if not please move to Section C

SECTION B – Paper already published

Where was the work published?			
When was the work published?			
If the work was published prior to registration for your research degree, give a brief rationale for its inclusion			
Have you retained the copyright for the work?*	Choose an item.	Was the work subject to academic peer review?	Choose an item.

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SECTION C – Prepared for publication, but not yet published

Where is the work intended to be published?	Tropical Medicine and International Health
Please list the paper's authors in the intended authorship order:	Caoimhe Cawley, Alison Wringe, Jim Todd, Annabelle Gourlay, Benjamin Clark, Clemens Masesa, Richard Machemba, Georges Reniers, Mark Urassa, Basia Zaba
Stage of publication	Submitted

SECTION D – Multi-authored work

For multi-authored work, give full details of your role in the research included in the paper and in the preparation of the paper. (Attach a further sheet if necessary)	I oversaw the entry of the routine clinic data and the linkage of clinic data to the Kisesa cohort dataset. I designed the linked dataset validation procedures and data analyses, and wrote the manuscript
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Student Signature:

Date: 14/04/2015

Supervisor Signature:

Date: 14/04/2015

4.1 Abstract

Objectives: To investigate the relative effectiveness of different HIV testing and counselling (HTC) services in improving HIV diagnosis rates and increasing HTC coverage in African settings.

Methods: Patient records from three HTC services (community outreach HTC during cohort study rounds (CO-HTC), walk-in HTC at the local health centre (WI-HTC) and antenatal HIV testing (ANC-HTC)) were linked to records from a community cohort study using a probabilistic record linkage algorithm. Characteristics of linked users of each HTC service were compared to those of cohort participants who did not use the HTC service using logistic regression. Data from three cohort study rounds between 2003 and 2010 were used to assess trends in the proportion of persons testing at different service types.

Results: The adjusted odds ratios for HTC use among individuals with increasing numbers of sexual partners in the past year, and among HIV-positive individuals compared to HIV-negative individuals, were higher at WI-HTC than CO-HTC and ANC-HTC. Among participants at each survey round, a higher proportion had ever used CO-HTC compared to the other services, and CO-HTC also diagnosed the largest numbers of HIV-positive persons.

Conclusions: While the odds of attracting high-risk or infected individuals was greatest at WI-HTC compared to CO-HTC or ANC-HTC, the overall proportion of infected persons diagnosed was highest at CO-HTC. Further research should compare the effectiveness of the three services in effecting sexual behaviour change, and investigate which services most effectively link HIV-positive people to treatment services relative to the total cost per diagnosis made.

4.2 Introduction

HIV testing and counselling (HTC) serves as the point of diagnosis and entry into care for HIV-positive individuals. It may also confer prevention benefits as a result of changes in sexual risk behaviour in HIV-negative and positive persons (23, 146), and via viral load suppression if HIV-positive individuals can be successfully linked to HIV care and treatment (30, 147).

The traditional model of HTC service delivery in many countries in sub-Saharan Africa has been at dedicated voluntary counselling and testing (VCT) centres, provided either as stand-alone services or at clinics attached to health facilities. In response to a need to increase VCT uptake in sub-Saharan Africa (148), and in recognition that alternative models of service delivery may help to reach underserved groups, there has been a drive to diversify strategies for HTC service provision (8). These include HTC services offered routinely to pregnant women at antenatal clinics (ANC), or to attendees of out-patient departments such as sexually transmitted infection or tuberculosis clinics (provider-initiated testing and counselling or PITC) (7, 8). Additional options for service provision include door-to-door testing provided to people in their homes, or temporary or mobile VCT units which are often provided in remote or rural communities ('outreach' testing) (64, 70, 149).

Little is known regarding the relative effectiveness of different HTC models in attracting people with risky behaviours or HIV infection, or in identifying the greatest absolute numbers of HIV-positive individuals at an early stage of infection – the latter group being particularly important to identify for treatment as prevention programmes (147). We use community cohort data linked to facility records from three different HTC services in northwest Tanzania (community outreach testing (CO-HTC), a walk-in HTC centre at a health facility (WI-HTC), and an antenatal testing service (ANC-HTC)), to compare socio-demographic, behavioural and clinical factors associated with HTC service use. We also assess trends in the proportion of persons tested at different service types between 2003 and 2010, by HIV-status and socio-demographic characteristics.

4.3 Methods

4.3.1 Study setting

The Kisesa HIV community cohort study includes six villages and has conducted 28 approximately half-yearly rounds of demographic surveillance since 1994, collecting information on residence and survival status of household members, pregnancy, births and migration. Seven rounds of serological and behavioural surveillance (sero-surveys) have been completed every two-three years over the same period, with eligibility defined as being resident at the last demographic surveillance round and aged 15 or older at the time of the sero-survey. Participants are invited to a central location in each village to give finger prick blood samples for HIV research testing without results disclosure, complete an interview questionnaire on health and HIV-related knowledge and behaviours, and are offered free medical treatment for health problems (142, 150).

4.3.2 HIV testing and counselling services in the study area

Three HTC services are available in the study area: i) a community outreach HTC (CO-HTC) service operates within each village for the duration of the sero-survey, since the fourth round in 2003/4; ii) a walk-in HTC (WI-HTC) clinic has been available at the main health centre in the study area's trading centre since 2005; iii) PITC has been routinely offered to pregnant women attending the health centre ANC since the roll out of a prevention to mother-to-child transmission (PMTCT) programme in 2008. Antenatal testing (ANC-HTC) may be carried out in the ANC or WI-HTC building, dependant on the availability of staff and test-kit supplies. All HTC services are provided free of charge.

4.3.3 Data sources – cohort data

During three sero-surveys in 2003/4 (Sero4), 2006/7 (Sero5) and 2010 (Sero6), data on participants' socio-demographic characteristics, sexual and health-seeking behaviours and reported prior use of any HTC services were collected. HIV-status for all study participants was determined using research test results.

4.3.4 Data sources – HTC data

Data on CO-HTC use were obtained by linking unique anonymous identifiers assigned to those using the service to their research study record. Data from the WI-HTC, including data on ANC-HTC which occurred within the WI-HTC building, were double-entered for the period 2005-2012 (partial data for 2012). A probabilistic record linkage algorithm was developed to match users of the clinic HTC services (WI-HTC and ANC-HTC) to cohort study participants, based on measures of similarity ('match-scores') between personal identifiers (name, sex, date of birth, village) in the two datasets (151). The CO-HTC dataset was used as a gold standard to train the record linkage algorithm. After validation procedures, 36.8% (4,046/10,994) of Kisesa resident clients using WI-HTC or ANC-HTC at the health centre between 2005 and 2012 were matched to the cohort dataset. The final linked dataset had low sensitivity (estimated at 17.8% based on the proportion of correctly matched gold-standard links) but a positive predictive value (PPV) of 68.9%.

4.3.5 Statistical methods

The investigation of risk factors for CO-HTC use compared the characteristics of all those who used the service compared to all those who did not use the service during Sero6 (Table 4.1). For the analysis of WI-HTC and ANC-HTC use, cohort participants who were matched to a WI-HTC or ANC-HTC client but with a low match-score below a cut-off threshold were dropped from the dataset, because the accuracy of the match could not be confidently ascertained. The analyses assessing risk factors for WI-HTC and ANC-HTC use therefore used case-control methods. For WI-HTC use, cases were defined as Sero6 participants who were linked to a WI-HTC client with a clinic visit occurring within two years of participation in Sero6. For cases with repeat WI-HTC (18/187), only the first testing visit was used. Controls were defined as Sero6 participants who were not linked to any WI-HTC clinic record (Table 4.1).

For the analysis of risk factors associated with ANC-HTC use, women attending either Sero5 or Sero6 were included in order to increase sample size. Cases were defined as women who participated in Sero5, reported a pregnancy between 2007-2010 and were linked to an ANC-HTC client with a testing visit within three years of Sero5, or women who participated in Sero6, reported a pregnancy between 2010-

2012 and were linked to an ANC-HTC client with a testing visit within two years of Sero6. For cases with repeat ANC-HTC (3/153), only the first testing visit was used. Controls were defined as women who participated in either Sero5 or Sero6, who reported a pregnancy between 2007-2010 (Sero5 attendees) or 2010-2012 (Sero6 attendees) and who were not linked to any ANC-HTC clinic record (Table 4.1). A proportion of controls (11/78) (but no cases) participated in both Sero5 and Sero6; these were randomly assigned as a control for one or other round.

Table 4.1 Methods, data sources and definitions for analyses of factors associated with CO-HTC, WI-HTC and ANC-HTC use

Testing service type	Method of analysis	Data source	Definition of case	Number of cases	Definition of control	Number of controls
CO-HTC	Cross sectional	All Sero 6 participants	All those who used CO-HTC at Sero6	2,040	All those who did not use CO-HTC at Sero6	5,968
WI-HTC	Case-control	Sero 6 participants	Sero6 participant linked to a WI-HTC client, with WI-HTC visit within two years of Sero6 participation	187	Sero6 participant not linked to a WI-HTC client	815
ANC-HTC	Case-control	Sero5 and Sero6 participants	<p>Female Sero5 participant, reported a pregnancy between 2007-2010 and linked to ANC-HTC client with ANC-HTC visit within three years of Sero5 participation</p> <p>OR</p> <p>Female Sero6 participant, reported a pregnancy between 2010-2012 and linked to ANC-HTC client with ANC-HTC visit within two years of Sero6 participation</p>	153	<p>Female Sero5 participant with reported pregnancy between 2007-2010 and not linked to an ANC-HTC client</p> <p>OR</p> <p>Female Sero6 participant with reported pregnancy between 2010-2012 and not linked to an ANC-HTC client</p>	76

Logistic regression models were fitted separately for men and women to identify characteristics independently associated with CO-HTC, WI-HTC or ANC-HTC, using a forward-fitting approach and including all variables significant in univariable analyses at the $p \leq 0.10$ level. Likelihood ratio tests were used to assess the inclusion of variables in multivariable models (variable retained if it significantly improved model fit at $p \leq 0.10$ level). Interactions were explored between HIV status and other characteristics previously found to be strongly associated with HTC use in this setting (area of residence, level of education and previous HTC use) (43, 152). Trends in the proportion of persons testing at different service types were assessed using data on actual or reported HTC use among participants of Sero4, Sero5 and Sero6, by HIV-status and socio-demographic characteristics. All statistical analyses were carried out in Stata 12 (StataCorp, Texas, USA).

4.3.6 Ethical statement

Ethical approval for the activities carried out as part of the Kisesa cohort study, including linkage of WI-HTC and ANC-HTC clinic data to the research study dataset, has been granted by the Tanzanian Medical Research Coordinating Committee and the Ethics Committee of the London School of Hygiene and Tropical Medicine. Participation in sero-surveys is based on informed consent without disclosure of HIV-research test results, with a free CO-HTC service available since Sero4 in 2003/4 (just prior to the start of the Tanzanian national antiretroviral therapy programme). Verbal consent was obtained during Sero4, due to low literacy rates among the study population. This was witnessed and documented for each participant on their study questionnaire, by a member of the sero-survey team. During Sero5 and Sero6 written consent was introduced (either a signature or a thumb-print, depending on the participant's writing ability).

4.4 Results

The analysis of CO-HTC use among Sero6 attendees included 811 men and 1,229 women who used HTC, and 2,320 men and 3,648 women who did not use HTC. For WI-HTC there were 75 male and 112 female Sero6 participants who were linked to a WI-HTC client (cases), and 425 men and 390 women who were controls. For ANC-HTC, 153 pregnant women were tested and linked to a Sero5 (85) or Sero6 (68) participant, and 76 pregnant women were controls (58 in Sero5 and 31 in Sero6).

4.4.1 Characteristics of HTC users

In adjusted analyses, men and women aged ≥ 55 had significantly lower odds of using CO-HTC and WI-HTC compared to those aged 15-24 (Table 4.2 and Table 4.3). Among women, increasing educational attainment was associated with both CO-HTC and WI-HTC but not ANC-HTC (Table 4.3 and Table 4.4). Men and women living in roadside villages or in the trading centre had significantly higher odds of using all types of testing services compared to those living in rural villages, with the exception of WI-HTC use among women, where uptake was more equitable by area of residence (Table 4.2, Table 4.3, Table 4.4).

Self-reported prior HTC was strongly associated with use of all three testing service types. The odds of testing also increased significantly with increasing numbers of sexual partners in the past year for men and women using WI-HTC, but this was not the case for women using CO-HTC or ANC-HTC (Table 4.2, Table 4.3, Table 4.4).

There was some evidence that HIV-positive individuals were more likely to use WI-HTC compared to HIV-negatives. Among men, the results did not quite reach statistical significance (Table 4.2), however women who were HIV-positive < 3 years since first positive research test had higher odds of using WI-HTC compared to HIV-negatives (Table 4.3: aOR: 4.14, 95% CI 1.27-13.52). The result was just short of reaching statistical significance for women HIV-positive ≥ 3 years since first positive research test. In contrast, HIV-positive men and women were not more likely to use CO-HTC or ANC-HTC compared to HIV-negative individuals (Table 4.2, Table 4.3, Table 4.4). For CO-HTC use, there was an interaction between HIV status and previous HTC use. Men and women HIV-positive ≥ 3 years since first positive research test who reported previous HTC were significantly less likely to use CO-HTC than HIV negative individuals (OR men: 0.30, 95% CI 0.12-0.74. aOR women: 0.18, 95% CI 0.09-0.36). However, these individuals were not significantly more or less likely to use CO-HTC if they reported no prior HTC (OR men: 1.98, 95% CI 0.75-5.24. aOR women: 0.68, 95% CI 0.27-1.72. p values for interaction: men $p=0.01$, women $p=0.06$).

Table 4.2 Risk factors for community outreach HTC or walk-in HTC among men attending Sero6 in 2010¶

		Community outreach HTC (CO-HTC) [§]						Walk-in HTC (WI-HTC) ⁺					
		%											
		N	using	cOR	95% CI	aOR	95% CI	N	using	cOR	95% CI	aOR	95% CI
Total		3,131	25.9					500	15.0				
Age	15-24	1,494	19.7	1		1		167	16.8	1		1	
	25-34	458	37.6	2.45	1.95-3.08	1.14	0.84-1.54	43	23.3	1.5	0.67-3.40	0.58	0.21-1.61
	35-44	417	35.7	2.27	1.79-2.88	1.14	0.83-1.58	60	35.0	2.67	1.37-5.21	1.3	0.54-3.11
	45-54	313	32.6	1.97	1.51-2.58	1.03	0.73-1.47	48	12.5	0.71	0.28-1.83	0.4	0.13-1.22
	≥55	447	21.3	1.1	0.85-1.43	0.67	0.48-0.94	182	5.5	0.29	0.14-0.61	0.24	0.10-0.59
Area of residence	Rural	1,772	15.8	1		1		278	11.2	1		1	
	Roadside	763	36.3	3.04	2.50-3.69	2.61	2.09-3.26	124	20.2	2.01	1.13-3.58	2	1.04-3.85
	Trading Centre	596	42.8	3.98	3.24-4.90	3.43	2.72-4.33	98	19.4	1.92	1.03-3.58	1.27	0.62-2.61
Education	None	453	18.1	1				138	6.5	1			
	Primary 1-4	324	25.3	1.53	1.08-2.17			60	6.7	1.02	0.30-3.46		
	Primary 5-7	1,563	26.7	1.65	1.26-2.14			213	22.1	4.06	1.92-8.59		
	Secondary or higher	777	29.1	1.86	1.40-2.47			89	16.9	2.91	1.21-6.97		
Religion	Catholic	1,107	28.2	1				171	18.1	1			
	Other Christian	1,416	27.0	0.94	0.79-1.13			193	17.6	0.97	0.56-1.65		
	Traditional	530	15.8	0.48	0.37-0.63			121	5.8	0.28	0.12-0.65		
	Muslim	75	44.0	2	1.25-3.22			15	20.0	1.13	0.30-4.24		
Marital status	Never married	1,466	20.1	0.55	0.46-0.65			176	16.5	1.41	0.82-2.44		
	Married monogamous	1,325	31.5	1				253	12.3	1			
	Married polygamous	128	37.5	1.3	0.89-1.90			26	34.6	3.79	1.56-9.24		
	Widowed	46	13.0	0.33	0.14-0.77			23	8.7	0.68	0.15-3.05		
	Separated/divorced	97	33.0	1.07	0.69-1.66			18	16.7	1.43	0.39-5.23		
HIV status	Negative	2,947	25.9	1				472	14.2	1			
	<3 years since first positive research test	111	29.7	1.21	0.80-1.84			18	27.8	2.32	0.80-6.73		
	≥3 years since first positive research test	50	24.0	0.91	0.47-1.74			5	40.0	4.03	0.66-24.57		
Reported any previous HCT	No	2,005	19.2	1		1		386	8.8	1		1	
	Yes	863	45.5	3.52	2.96-4.19	2.13	1.74-2.61	111	36.9	6.06	3.60-10.22	5.15	2.79-9.50
Has an HIV positive relative	No	2,133	24.3	1		1		337	15.4	1			
	Yes	479	38.8	1.97	1.60-2.43	1.28	1.00-1.62	60	21.7	1.52	0.77-3.00		
	Don't know	274	29.2	1.28	0.97-1.69	1.25	0.92-1.71	103	9.7	0.59	0.29-1.21		

¶ All characteristics as reported at Sero6, § Cross sectional analysis, + Case-control analysis, cOR crude OR, CI confidence interval, aOR adjusted OR

Table 4.2 continued[¶]

		Community outreach HTC (CO-HTC) [§]						Walk-in HTC (WI-HTC) ⁺					
		N	% using	cOR	95% CI	aOR	95% CI	N	% using	cOR	95% CI	aOR	95% CI
Spouse HIV & VCT use status at Sero6	No spouse identified	2,444	24.9	1		1		354	17.0	1			
	Spouse HIV neg no VCT	484	19.4	0.73	0.57-0.93	0.56	0.42-0.75	112	6.3	0.33	0.14-0.74		
	Spouse HIV pos no VCT	29	31.0	1.36	0.62-3.00	0.72	0.30-1.72	7	28.6	1.96	0.37-10.34		
	Spouse HIV neg used VCT	163	58.3	4.22	3.05-5.84	2.26	1.55-3.28	23	21.7	1.36	0.49-3.81		
	Spouse HIV pos used VCT	10	60.0	4.53	1.27-16.10	2.82	0.73-10.88	3	33.3	2.45	0.22-27.45		
Age at first sex	<15	256	21.5	0.54	0.40-0.74	0.64	0.44-0.92	45	15.6	0.82	0.35-1.92		
	>=15	1,782	33.5	1		1		293	18.4	1			
	Never had sex ^γ	825	11.2	0.25	0.20-0.32	0.32	0.23-0.44	-	-	-	-		
	Don't know ^γ	237	27.4	0.75	0.55-1.01	0.82	0.58-1.16	158	8.9	0.43	0.23-0.80		
Number of sexual partners in last year	None	322	21.1	0.58	0.43-0.78	0.65	0.46-0.91	59	10.2	0.85	0.34-2.15	1.17	0.41-3.34
	One	1,315	31.6	1		1		247	11.7	1		1	
	Two or more	640	36.2	1.23	1.01-1.50	1.12	0.89-1.42	91	31.9	3.52	1.96-6.32	2.77	1.41-5.46
	Never had sex ^γ	825	11.2	0.27	0.21-0.35	*	*	-	-	-	-	-	-
	Don't know ^γ	-	-	-	-	-	-	98	11.2	0.95	0.45-1.99	0.87	0.33-2.28
Had a casual partner in last year	No	1,799	30.4	1				346	14.7	1			
	Yes	476	35.3	1.25	1.01-1.55			54	24.1	1.83	0.92-3.66		
	Never had sex ^γ	825	11.2	0.29	0.23-0.37			-	-	-	-		
	Don't know ^γ	-	-	-	-			98	11.2	0.73	0.37-1.46		
Frequency of condom use with spouse^α	Consistent	4	50.0	2.1	0.30-14.98			1	100.0	-	-		
	Inconsistent	106	43.4	1.61	1.08-2.41			12	50.0	6.48	1.97-21.30		
	Never	1,241	32.2	1				247	13.4	1			
	No spouse	830	30.2	0.91	0.75-1.10			113	19.5	1.57	0.87-2.84		
	Never had sex ^γ	825	11.2	0.26	0.21-0.34			-	-	-	-		
	Don't know ^γ	-	-	-	-			98	11.2	0.82	0.40-1.70		
Frequency condom use with regular partner^β	Consistent	39	33.3	1.12	0.57-2.19	0.62	0.30-1.28	6	33.3	2.94	0.52-16.42		
	Inconsistent	53	49.1	2.16	1.25-3.73	1.98	1.05-3.73	5	40.0	3.91	0.64-23.97		
	Never	116	30.2	0.97	0.64-1.45	1.2	0.75-1.91	15	40.0	3.91	1.34-11.44		
	No regular partner	2,044	30.9	1		1		371	14.6	1			
	Never had sex ^γ	825	11.2	0.28	0.22-0.36	*	*	-	-	-	-		
	Don't know ^γ	-	-	-	-	-	-	98	11.2	0.74	0.37-1.48		

[¶] All characteristics as reported at Sero6 in 2010, [§] Cross sectional analysis, ⁺ Case-control analysis, cOR crude OR, CI confidence interval, aOR adjusted OR

^γ Participants reporting 'never had sex' at Sero6 reassigned to 'don't know' category for WI-HTC analysis, because these testing visits happened *after* the time of data collection

*Omitted because of colinearity, ^α First/main spouse among men with more than one spouse, ^β First reported regular partner among those with more than one

Table 4.3 Risk factors for community outreach HTC or walk-in HTC among women attending Sero6 in 2010[¶]

		Community outreach HTC (CO-HTC) [§]						Walk-in HTC (WI-HTC) ⁺					
		%						%					
		N	using	cOR	95% CI	aOR	95% CI	N	using	cOR	95% CI	aOR	95% CI
Total		4,877	25.2					502	22.3				
Age	15-24	1,689	23.3	1		1		78	37.2	1		1	
	25-34	1,132	32.6	1.59	1.35-1.89	0.98	0.79-1.22	58	58.6	2.39	1.19-4.80	1.76	0.64-4.84
	35-44	819	31.3	1.5	1.25-1.81	0.99	0.77-1.25	52	55.8	2.13	1.04-4.35	2.5	0.87-7.21
	45-54	516	26.7	1.2	0.96-1.51	0.9	0.67-1.21	59	23.7	0.53	0.25-1.12	0.97	0.32-2.92
	≥55	720	9.9	0.36	0.28-0.47	0.34	0.23-0.50	255	2.4	0.04	0.02-0.10	0.43	0.11-1.61
Area of residence	Rural	2,493	14.0	1		1		258	20.2	1			
	Roadside	1,284	34.7	3.27	2.78-3.84	2.96	2.47-3.55	129	27.1	1.48	0.90-2.42		
	Trading Centre	1,100	39.5	4.02	3.40-4.74	3.81	3.14-4.61	115	21.7	1.1	0.64-1.88		
Education	None	1,829	17.7	1		1		324	10.5	1		1	
	Primary 1-4	314	28.3	1.84	1.40-2.41	1.33	0.98-1.80	27	29.6	3.59	1.46-8.83	4.42	1.31-14.95
	Primary 5-7	2,214	30.1	2	1.72-2.32	1.4	1.17-1.69	121	49.6	8.39	5.07-13.88	2.83	1.33-6.01
	Secondary or higher	510	28.6	1.86	1.49-2.34	1.6	1.18-2.16	30	33.3	4.26	1.84-9.86	2.31	0.74-7.27
Religion	Catholic	2,062	26.0	1		1		206	24.3	1			
	Other Christian	2,433	25.0	0.95	0.83-1.08	1.02	0.88-1.19	207	25.6	1.07	0.69-1.68		
	Traditional	253	12.3	0.4	0.27-0.58	0.89	0.57-1.39	67	4.5	0.15	0.04-0.49		
	Muslim	117	42.7	2.12	1.45-3.10	1.57	1.02-2.41	20	25.0	1.04	0.36-3.01		
Marital status	Never married	1,008	18.3	0.54	0.45-0.64	0.72	0.50-1.04	49	32.7	0.92	0.47-1.81	0.42	0.07-2.44
	Married monogamous	2,448	29.4	1		1		180	34.4	1		1	
	Married polygamous	402	29.6	1.01	0.80-1.27	1.11	0.86-1.44	44	45.5	1.59	0.81-3.09	1.49	0.66-3.36
	Widowed	512	13.1	0.36	0.28-0.47	0.57	0.36-0.89	152	2.0	0.04	0.01-0.13	1.71	0.23-12.50
	Separated/divorced	464	28.0	0.94	0.75-1.17	0.97	0.67-1.40	74	14.9	0.33	0.16-0.68	4.35	0.75-25.30
HIV Status	Negative	4,502	25.5	1		1		474	20.5	1		1	
	<3 years since first	246	24.0	0.92	0.68-1.24	0.59	0.42-0.82	21	57.1	5.18	2.12-12.65	4.14	1.27-13.52
	≥3 years since first												
	positive research test	113	14.2	0.48	0.28-0.82	0.26	0.15-0.46	6	50.0	3.89	0.77-19.56	11.6	0.68-198.17
Reported any previous HCT	No	2,911	17.5	1		1		396	15.2	1		1	
	Yes	1,894	37.3	2.82	2.47-3.22	1.49	1.27-1.75	103	48.5	5.28	3.29-8.49	1.89	0.95-3.79
Has an HIV positive relative	No	3,478	22.6	1		1		378	19.8	1			
	Yes	1,148	34.2	1.79	1.54-2.07	1.22	1.03-1.45	92	33.7	2.05	1.24-3.39		
	Don't know	199	24.1	1.09	0.78-1.52	0.86	0.59-1.25	32	18.8	0.93	0.37-2.35		

[¶] All characteristics as reported at Sero6 in 2010, [§] Cross sectional analysis, ⁺ Case-control analysis, cOR crude OR, CI confidence interval, aOR adjusted OR

Table 4.3 continued¶

		Community outreach HTC (CO-HTC) [§]						Walk-in HTC (WI-HTC) ⁺					
		N	% using	cOR	95% CI	aOR	95% CI	N	% using	cOR	95% CI	aOR	95% CI
Spouse HIV & VCT use status at Sero6	No spouse identified	4,180	25.3	1		1		425	21.9	1			
	Spouse HIV neg no VCT	450	14.0	0.48	0.37-0.63	0.55	0.41-0.75	62	24.2	1.14	0.61-2.13		
	Spouse HIV pos no VCT	2911	16.2	0.57	0.24-1.38	0.65	0.26-1.65	5	40.0	2.38	0.39-14.45		
	Spouse HIV neg used VCT	196	49.5	2.9	2.17-3.87	2.17	1.57-3.00	8	25.0	1.19	0.24-5.99		
	Spouse HIV pos used VCT	9	44.4	2.37	0.63-8.83	2.49	0.59-10.41	-	-	-	-		
Age at first sex	<15	467	20.6	0.6	0.48-0.77	0.75	0.57-0.97	78	21.8	0.86	0.47-1.55		
	>=15	3,431	30.0	1		1		318	24.5	1			
	Never had sex ^γ	612	8.7	0.22	0.17-0.30	0.25	0.16-0.39	-	-	-	-		
	Don't know ^γ	337	13.9	0.38	0.28-0.52	0.67	0.47-0.95	102	16.7	0.62	0.34-1.10		
Number of sexual partners in last year	None	858	16.6	0.46	0.38-0.56	1.09	0.75-1.58	225	1.8	0.03	0.01-0.07	0.03	0.00-0.22
	One	3,261	30.1	1		1		231	40.7	1		1	
	Two or more	100	44.0	1.83	1.22-2.73	1.81	1.15-2.86	4	50.0	1.46	0.20-10.53	0.2	0.01-4.04
	Never had sex ^γ	612	8.7	0.22	0.16-0.29	*	*	-	-	-	-	-	-
	Don't know ^γ	-	-	-	-	-	-	36	33.3	0.73	0.35-1.53	2.51	0.42-14.95
Had a casual partner in last year	No	4,007	27.3	1				457	20.4	1		1	
	Yes	211	33.6	1.35	1.01-1.81			9	77.8	13.7	2.80-67.03	10.3	0.72-146.02
	Never had sex ^γ	612	8.7	0.25	0.19-0.34			-	-	-	-	-	-
	Don't know ^γ	-	-	-	-			36	33.3	1.96	0.94-4.06	*	*
Frequency of condom use with spouse	Consistent	0	0					-	-	-	-	-	-
	Inconsistent	309	39.5	1.65	1.30-2.11			18	77.8	43	12.81-144.19	3.13	0.88-11.07
	Never	2,458	28.3	1				192	35.4	6.73	3.83-11.84	*	*
	No spouse	1,389	23.8	0.79	0.68-0.92			239	7.5	1		1	
	Never had sex ^γ	612	8.7	0.24	0.18-0.32			-	-	-	-	-	-
	Don't know ^γ	-	-	-	-			36	33.3	6.14	2.64-14.27	*	*
Frequency condom use with regular partner^β	Consistent	39	33.3	1.38	0.71-2.69	0.93	0.43-1.99	3	33.3	1.94	0.17-21.62		
	Inconsistent	153	45.8	2.33	1.68-3.22	1.64	1.06-2.55	8	62.5	6.46	1.52-27.55		
	Never	206	32.0	1.3	0.96-1.76	1.4	0.93-2.12	11	36.4	2.22	0.63-7.74		
	No regular partner	3,814	26.6	1		1		439	20.5	1			
	Never had sex ^γ	612	8.7	0.26	0.20-0.35	*	*	-	-	-	-	-	-
	Don't know ^γ	-	-	-	-			36	33.3	1.94	0.93-4.03		

¶ All characteristics as reported at Sero6 in 2010, § Cross sectional analysis, + Case-control analysis, cOR crude OR, CI confidence interval, aOR adjusted OR

γ Participants reporting 'never had sex' at Sero6 reassigned to 'don't know' category for WI-HTC analysis, because these testing visits happened *after* the time of data collection

* Omitted because of colinearity, β First reported regular partner among those with more than one

Table 4.4 Risk factors for ANC-HTC among women attending Sero5 or Sero6 and reporting pregnancies between 2007-2010 (Sero5 attendees) or 2010-2012 (Sero6 attendees)[†] +

		N	% using	cOR	95% CI	aOR	95% CI
Total		229	66.8				
Age	15-24	58	60.3	1			
	25-34	117	71.8	1.67	0.86-3.24		
	35-44	44	68.2	1.41	0.62-3.21		
	45-54	10	40.0	0.44	0.11-1.72		
Area of residence	Rural	114	53.5	1		1	
	Roadside	73	86.3	5.47	2.55-11.73	6.25	2.66-14.58
	Trading Centre	42	69.1	1.94	0.91-4.11	2.39	0.97-5.86
Education	None	78	65.4	1			
	Primary 1-4	14	78.6	1.94	0.50-7.56		
	Primary 5-7	122	68.9	1.17	0.64-2.14		
	Secondary or higher	14	42.9	0.4	0.12-1.26		
Religion	Catholic	82	65.9	1			
	Other Christian	122	68.0	1.1	0.61-2.00		
	Traditional	17	52.9	0.58	0.20-1.68		
	Muslim	8	87.5	3.63	0.43-30.99		
Marital status	Never married	25	48.0	0.35	0.15-0.83		
	Married monogamous	166	72.3	1			
	Married polygamous	26	57.7	0.52	0.22-1.22		
	Widowed	2	0.0	-	-		
	Separated/divorced	10	60.0	0.58	0.16-2.13		
HIV Status	Negative	220	66.8	1			
	<3 years since first positive research test	5	60.0	0.74	0.12-4.56		
	≥3 years since first positive research test	3	66.7	0.99	0.09-11.13		
Reported any previous HCT	No	162	60.5	1		1	
	Yes	66	81.8	2.94	1.46-5.92	2.35	1.07-5.13
Spouse HIV & VCT use status at Sero6							
	No spouse identified	167	61.7	1		1	
	Spouse HIV neg, no VCT	34	82.4	2.9	1.14-7.39	6.58	2.11-20.57
	Spouse HIV pos, no VCT	2	50.0	0.62	0.04-10.11	0.53	0.02-11.91
	Spouse HIV neg, used VCT	25	80.0	2.49	0.89-6.95	4.08	1.13-14.80
	Spouse HIV pos, used VCT	-	-	-	-	-	-
Has an HIV positive relative	No	166	70.5	1		1	
	Yes	42	71.4	1.05	0.50-2.21	0.73	0.30-1.78
	Don't know	21	28.6	0.17	0.06-0.46	0.18	0.06-0.60
Age at first sex	<15	11	63.6	0.79	0.22-2.78		
	≥15	200	69.0	1			
	Don't know	18	44.4	0.36	0.14-0.95		
Number of sexual partners in last year	None	6	66.7	0.88	0.16-4.93		
	One	203	69.5	1			
	Two or more	10	50.0	0.44	0.12-1.57		
	Don't know	10	30.0	0.19	0.05-0.75		
Had a casual partner in last year	No	205	67.3	1		1	
	Yes	14	85.7	2.91	0.63-13.39	3.37	0.59-19.19
	Don't know	10	30.0	0.21	0.05-0.83	0.34	0.07-1.51

† Pooled analysis - characteristics as reported at either Sero5 (2006/7) or Sero6 (2010)

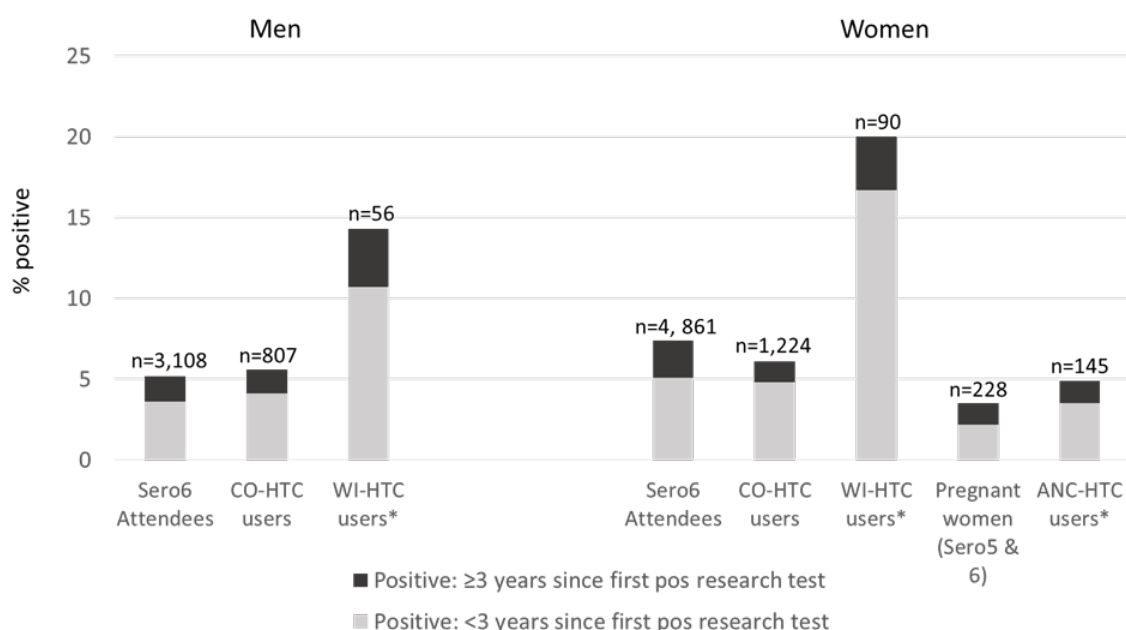
+ Case-control analysis

cOR crude OR, CI confidence interval, aOR adjusted OR

4.4.2 HIV prevalence by service type

HIV prevalence was highest among WI-HTC users (men: 14%, women: 20%) compared to CO-HTC users (men: 5.6%, women: 6.1%) or ANC-HTC users (4.9%) (Figure 4.1). We were missing substantial proportions of test result data for WI-HTC clients (25% of male and 20% of female clients), however even if all of these test-results had been negative, HIV-prevalence would still have been higher among WI-HTC users (men: 10.7%, women: 16.1%) compared to the other service types. Among HIV-positive individuals, the proportions testing at an early stage of infection (<3 years since first positive research test) were similar regardless of testing service type (Figure 4.1. Men CO-HTC: 73.3%, WI-HTC: 75%. Women: CO-HTC: 78.7%, WI-HTC: 83.3%, ANC-HTC: 71.4).

Figure 4.1 Proportion testing HIV-positive by time since first positive research test and HTC service type[¶]



[¶] Categories 'Sero6 attendees' and 'Pregnant women (Sero5 & 6)' shown for reference. HIV diagnosis based on sero-survey research test results except for WI-HTC and ANC-HTC users, where diagnosis based on WI-HTC or ANC-HTC clinic test results.

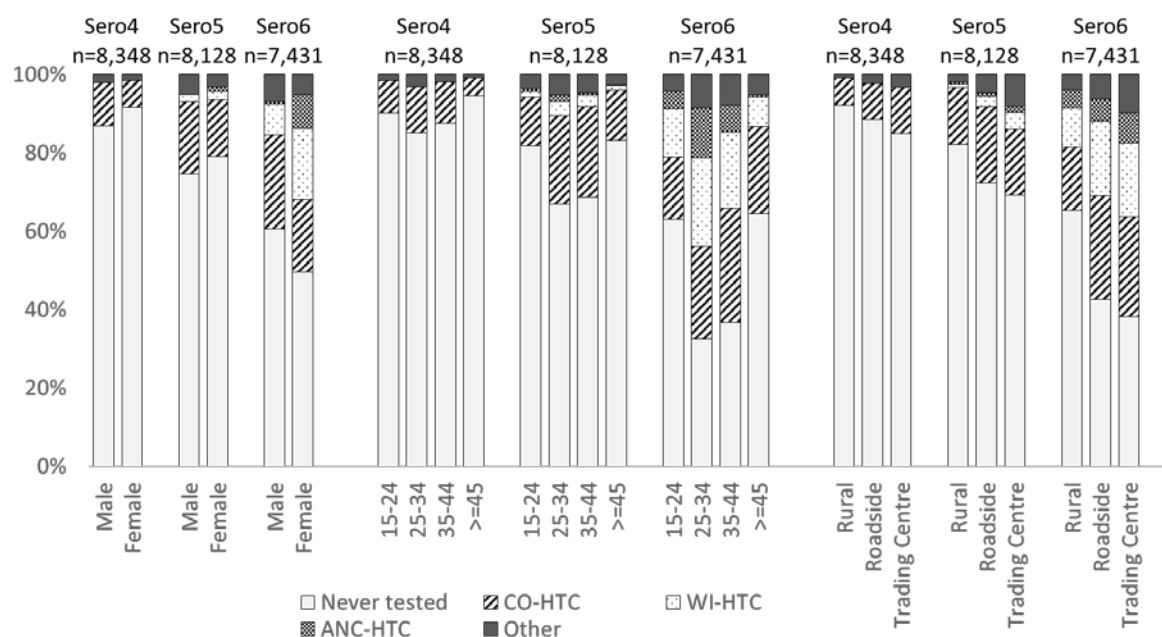
*Missing clinic test result data for 19/75 (25%) male WI-HTC users, 22/112 (20%) female WI-HTC users and 8/153 (5%) ANC-HTC users

4.4.3 Trends in the proportion of persons ever tested by HIV status

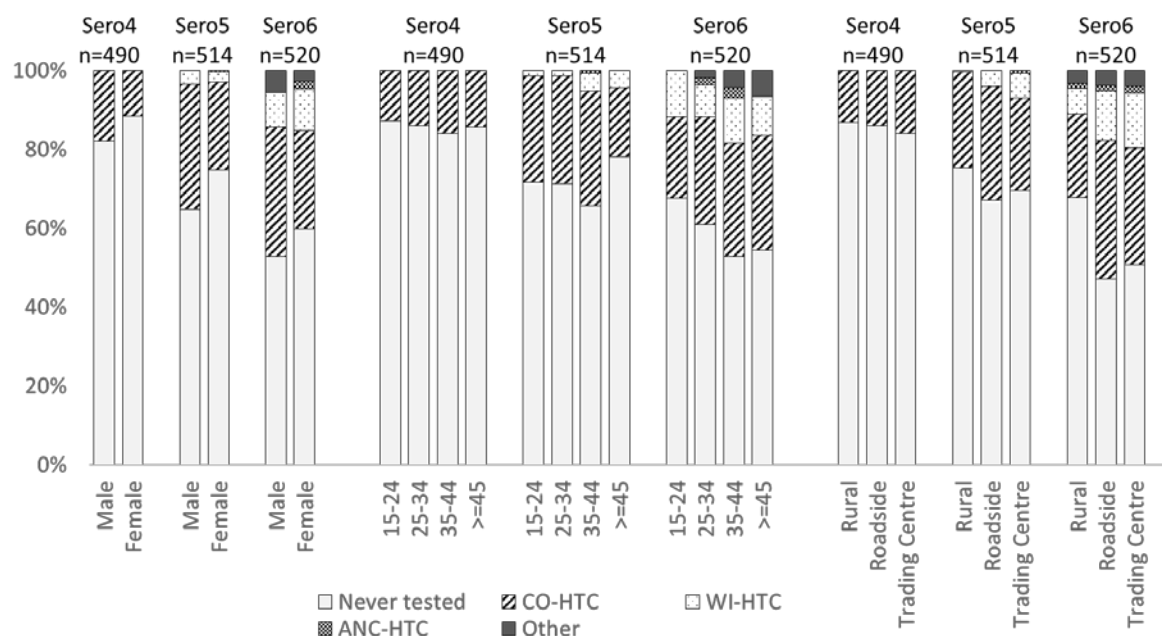
The number of HIV-negative individuals receiving their first test at WI-HTC or ANC-HTC has grown over time, particularly among women and those aged 25-44 (Figure 4.2a). By Sero6, similar proportions of HIV-negative women had first tested at CO-HTC (18.6%) or WI-HTC (18.1%), while the greatest proportion of HIV-negative men had first tested at CO-HTC (23.9%, versus 7.9% first testing at WI-HTC). HIV diagnosis rates were highest at CO-HTC, accounting for 32.9% of all HIV-positive men and 24.8% of all HIV-positive women by Sero6 (Figure 4.2b).

Figure 4.2 Location of a) first test (HIV-negatives) or b) diagnosis (HIV-positives) based on actual or reported HTC use among attendees of Seros 4, 5 and 6 by sex, age-group and area of residence

a) Location of first test among individuals testing HIV-negative



b) Location of diagnosis among previously undiagnosed HIV-positive individuals*



* Proportions diagnosed at WI-HTC, ANC-HTC or other locations in the study area may be under-estimates due to unknown results at time of testing for positive individuals reporting HTC use in the past (4% of Sero4 data, 10% of Sero5 data, 35% of Sero6 data)

4.5 Discussion

Our results revealed that WI-HTC was more likely to attract higher risk individuals (those with larger numbers of sexual partners) and HIV-positive men and women compared to the other testing modalities. This is in agreement with other studies which have found that stand-alone or clinic based HTC identified larger proportions of HIV-positive patients compared to mobile or outreach testing services (64, 67, 77). Users of client initiated WI-HTC services may be motivated by recent exposures or by suspicions that they are HIV-infected, due to symptoms or death of a partner. Conversely, CO-HTC and ANC-HTC represent more passive opportunities to test, and therefore seem to attract relatively fewer high-risk individuals. However, the aforementioned studies found that outreach testing services were better at facilitating earlier HIV diagnosis compared to clinic based services, which tended to diagnose patients at a later stage of infection. In this study, we found no substantial differences in HIV diagnoses by stage of infection by testing service type, but our analyses were limited by small sample sizes, particularly for users of WI-HTC and ANC-HTC.

Among sero-survey participants, the largest numbers of HIV-positive men and women learned their status via CO-HTC. However this may not be true in the wider population, if we had been able to take account of WI-HTC and/or ANC-HTC use among individuals who didn't attend sero-surveys. We may also have underestimated the numbers diagnosed at WI-HTC and ANC-HTC, due to low linkage sensitivity and reliance on reports of HTC use in the past for which we did not know test results (for 4% of HIV-positive individuals at Sero4, 10% of HIV-positive individuals at Sero5, 35% of HIV-positive individuals at Sero6). Nevertheless, CO-HTC is likely to represent an efficient model of service delivery in which large numbers of people were reached in a short period of time. Achieving high HTC uptake is an important objective of HIV prevention programmes in sub-Saharan Africa, and a number of studies have found that rates of uptake are highest when testing is provided as an outreach service (64, 67, 70, 71). However in terms of treatment as prevention it will be important that services can be regularly accessed, and to understand which services most effectively link HIV-positive individuals to care and treatment (153).

The three main HTC services in this setting attracted users with different socio-demographic profiles. Overall WI-HTC attracted a greater proportion of women than men, while the proportions of women and men using CO-HTC were more even (Figure 4.2). By Sero6 in 2010, a larger proportion of women had ever tested at any HTC service compared to men. These findings concur with other studies which found that men were less likely to use health facility based HTC compared to women (77, 80) and that larger numbers of women had ever tested overall (41, 56).

In adjusted analyses WI-HTC was less likely to attract individuals aged ≥ 55 compared to those aged 15-24, and less likely to recruit women with no education compared to those with primary education. While similar patterns for age-group and level of education were seen for CO-HTC, the measures of effect were not as strong. A number of studies have shown that outreach testing and some types of PITC reach proportionately older and less educated clients compared to walk-in HTC (76-78), and we similarly found that access to CO-HTC and ANC-HTC appeared more equitable in terms of these socio-demographic characteristics compared to WI-HTC. However, there were inequities in access by area of residence for all testing service types, with the exception of WI-HTC use among women. It was somewhat surprising that men and women living in rural areas were considerably less likely to use CO-HTC seeing as this service was provided within the village. Larger distances to the health centre (where HIV care services are available), perceived lack of need, stigma or residual confounding by unmeasured socio-economic factors may be some of the reasons explaining this finding. Policies which aim to promote and normalise HTC in rural villages may help to increase the uptake of testing in these areas.

Unlike many studies relying on data collected at HTC clinics, a key strength of our analysis was the linkage of community cohort and clinic data, allowing comparison of factors associated with uptake of three different HTC services at the community level. Nevertheless, the linkage procedures are likely to have introduced some biases which need consideration. WI-HTC clinic records included for analyses were less likely to be male compared to records not included (24% versus 29%, $p < 0.001$). This may have led us to under-estimate the proportions of men using WI-HTC. Linked individuals included in the WI-HTC and ANC-HTC analyses were also more likely to be older ($p < 0.001$) and less likely to have secondary education ($p = 0.002$).

compared to those not included, which may have led us to under-estimate the strength of associations between age and/or educational attainment and WI-HTC or ANC-HTC use.

Sensitivity analyses were explored which increased the PPV of the linked WI-HTC and ANC-HTC clinic-cohort datasets from 68.9% to 85.0%. These did not change the overall direction of any of our findings (see Supplementary Tables 4.5 to 4.7 below), although in some cases they strengthened associations (as expected given that random error should be reduced in higher PPV datasets), giving confidence in our findings. An additional strength of our study was the ability to explore associations between HIV status and HTC use due to knowledge of HIV status among both testers and non-testers. However, small sample sizes may have prevented us from detecting weaker effects for some risk factors among WI-HTC and ANC-HTC users.

4.6 Conclusions

Of the three services available, the odds of attracting high-risk or infected individuals was greatest at WI-HTC, but the overall proportion of infected persons diagnosed was higher at CO-HTC. Further research should compare the effectiveness of the three services in influencing sexual behaviour change, and investigate which services most effectively link HIV-positive people to treatment services relative to the total cost per diagnosis made.

Supplementary tables (not included as part of submitted manuscript)

Table 4.5 Sensitivity analyses assessing crude ORs for WI-HTC use among men using datasets with PPV 68.9%, 75.0% and 85.0%

		PPV 68.9%		PPV 78.5%		PPV 85.0%	
		cOR	95% CI	cOR	95% CI	cOR	95% CI
Age	15-24	1		1		1	
	25-34	1.5	0.67-3.40	0.67	0.22-2.07	1.2	0.37-3.89
	35-44	2.67	1.37-5.21	2.71	1.35-5.42	4.33	1.96-9.55
	45-54	0.71	0.28-1.83	0.79	0.31-2.07	1.42	0.51-3.92
	≥55	0.29	0.14-0.61	0.32	0.15-0.70	0.52	0.22-1.24
Area of residence	Rural	1		1		1	
	Roadside	2.01	1.13-3.58	1.87	1.01-3.45	2.25	1.14-4.42
	Trading Centre	1.92	1.03-3.58	1.67	0.85-3.29	1.88	0.88-4.01
Education	None	1		1		1	
	Primary 1-4	1.02	0.30-3.46	0.99	0.25-3.96	1.15	0.20-6.47
	Primary 5-7	4.06	1.92-8.59	4.55	1.98-10.48	6.8	2.36-19.62
	Secondary or higher	2.91	1.21-6.97	3.24	1.24-8.47	3.92	1.17-13.18
Religion	Catholic	1		1		1	
	Other Christian	0.97	0.56-1.65	1.14	0.64-2.03	0.92	0.49-1.75
	Traditional	0.28	0.12-0.65	0.36	0.15-0.86	0.29	0.11-0.80
	Muslim	1.13	0.30-4.24	1.11	0.23-5.32	1.11	0.23-5.32
Marital status	Never married	1.41	0.82-2.44	1.51	0.84-2.73	0.92	0.46-1.84
	Married monogamous	1		1		1	
	Married polygamous	3.79	1.56-9.24	4.7	1.90-11.65	4.54	1.77-11.67
	Widowed	0.68	0.15-3.05	0.85	0.19-3.82	0.92	0.20-4.17
	Separated/divorced	1.43	0.39-5.23	1.18	0.26-5.48	1.29	0.28-5.98
HIV status	Negative	1		1		1	
	<3 years since first positive research test	2.32	0.80-6.73	2.78	0.96-8.10	3.62	1.23-10.65
	≥3 years since first positive research test	4.03	0.66-24.57	4.82	0.79-29.49	6.28	1.20-38.62
Reported any previous HCT	No	1		1		1	
	Yes	6.06	3.60-10.22	5.7	3.28-9.92	8.94	4.75-16.82
Has an HIV positive relative	No	1		1		1	
	Yes	1.52	0.77-3.00	1.65	0.81-3.36	1.78	0.83-3.85
	Don't know	0.59	0.29-1.21	0.56	0.25-1.23	0.54	0.22-1.33
Spouse HIV & VCT use status at Sero6	No spouse identified	1		1		1	
	Spouse HIV neg no VCT	0.33	0.14-0.74	0.4	0.18-0.91	0.54	0.24-1.26
	Spouse HIV pos no VCT	1.96	0.37-10.34	2.4	0.45-12.72	3.27	0.61-17.46
	Spouse HIV neg used VCT	1.36	0.49-3.81	1.67	0.59-4.70	1.81	0.58-5.66
	Spouse HIV pos used VCT	2.45	0.22-27.45	3	0.27-33.72	4.08	0.36-46.16
Age at first sex	<15	0.82	0.35-1.92	0.82	0.33-2.05	0.79	0.29-2.12
	≥15	1		1		1	
	Don't know	0.43	0.23-0.80	0.43	0.22-0.84	0.21	0.08-0.54
Number of sexual partners in last year	None	0.85	0.34-2.15	0.86	0.31-2.35	0.82	0.27-2.51
	One	1		1		1	
	Two or more	3.52	1.96-6.32	3.66	1.96-6.86	4.04	2.09-7.84
	Don't know	0.95	0.45-1.99	1.04	0.48-2.27	0.38	0.11-1.30
Had a casual partner in last year	No	1		1		1	
	Yes	1.83	0.92-3.66	1.84	0.88-3.85	1.94	0.90-4.20
	Don't know	0.73	0.37-1.46	0.79	0.38-1.63	0.27	0.08-0.91
Frequency of condom use with spouse^α	Consistent	*	*	*	*	*	*
	Inconsistent	6.48	1.97-21.30	6.15	1.76-21.43	6.86	1.96-24.05
	Never	1		1		1	
	No spouse	1.57	0.87-2.84	1.46	0.77-2.76	1.27	0.63-2.54
	Don't know	0.82	0.40-1.70	0.85	0.40-1.82	0.28	0.08-0.96
Frequency condom use with regular partner^β	Consistent	2.94	0.52-16.42	1.65	0.18-15.08	1.87	0.21-17.28
	Inconsistent	3.91	0.64-23.97	4.4	0.72-27.03	2.52	0.26-24.74
	Never	3.91	1.34-11.44	2.2	0.58-8.42	2.52	0.66-9.66
	No regular partner	1		1		1	
	Don't know	0.74	0.37-1.48	0.76	0.37-1.56	0.26	0.08-0.86

α First/main spouse among men with more than one spouse, * Too few data to calculate OR

β First reported regular partner among those with more than one

Table 4.6 Sensitivity analyses assessing crude ORs for WI-HTC use among women using datasets with PPV 68.9%, 75.0% and 85.0%

		PPV 68.9%		PPV 75.0%		PPV 85.0%	
		cOR	95% CI	cOR	95% CI	cOR	95% CI
Age	15-24	1		1		1	
	25-34	2.39	1.19-4.80	2.6	1.24-5.46	3.3	1.41-7.69
	35-44	2.13	1.04-4.35	2.71	1.29-5.72	3.28	1.39-7.72
	45-54	0.53	0.25-1.12	0.64	0.29-1.43	0.92	0.37-2.26
	≥55	0.04	0.02-0.10	0.05	0.02-0.14	0.06	0.02-0.19
Area of residence	Rural	1		1		1	
	Roadside	1.48	0.90-2.42	1.4	0.83-2.35	1.8	0.98-3.29
	Trading Centre	1.1	0.64-1.88	0.97	0.55-1.74	1.47	0.77-2.80
Education	None	1		1		1	
	Primary 1-4	3.59	1.46-8.83	3.56	1.38-9.16	3.52	1.29-9.59
	Primary 5-7	8.39	5.07-13.88	8.08	4.76-13.71	6.03	3.37-10.81
	Secondary or higher	4.26	1.84-9.86	4.35	1.82-10.40	2.23	0.71-7.02
Religion	Catholic	1		1		1	
	Other Christian	1.07	0.69-1.68	1.11	0.69-1.78	1.15	0.67-1.99
	Traditional	0.15	0.04-0.49	0.17	0.05-0.58	0.17	0.04-0.73
	Muslim	1.04	0.36-3.01	1.24	0.43-3.60	1.43	0.44-4.63
Marital status	Never married	0.92	0.47-1.81	1.01	0.51-2.02	0.55	0.21-1.41
	Married monogamous	1		1		1	
	Married polygamous	1.59	0.81-3.09	1.58	0.78-3.18	1.64	0.76-3.53
	Widowed	0.04	0.01-0.13	0.03	0.01-0.13	0.04	0.01-0.17
	Separated/divorced	0.33	0.16-0.68	0.35	0.17-0.74	0.43	0.20-0.95
HIV status	Negative	1		1		1	
	<3 years since first positive research test	5.18	2.12-12.65	5.55	2.23-13.83	7.48	2.91-19.21
	≥3 years since first positive research test	3.89	0.77-19.56	4.54	0.90-22.90	6.73	1.33-34.20
Reported any previous HCT	No	1		1		1	
	Yes	5.28	3.29-8.49	4.73	2.87-7.77	5.98	3.43-10.43
Has an HIV positive relative	No	1		1		1	
	Yes	2.05	1.24-3.39	2.17	1.29-3.66	2.54	1.42-4.55
	Don't know	0.93	0.37-2.35	0.91	0.34-2.46	1.08	0.36-3.26
Spouse HIV & VCT use status at Sero6	No spouse identified	1		1		1	
	Spouse HIV neg no VCT	1.14	0.61-2.13	1.36	0.72-2.55	1.28	0.61-2.69
	Spouse HIV pos no VCT	2.38	0.39-14.45	2.84	0.47-17.27	4.02	0.66-24.63
	Spouse HIV neg used VCT	1.19	0.24-5.99	1.42	0.28-7.16	2.01	0.40-10.22
	Spouse HIV pos used VCT	-	-	-	-	-	-
Age at first sex	<15	0.86	0.47-1.55	1.01	0.55-1.85	1.23	0.65-2.34
	≥15	1		1		1	
	Don't know	0.62	0.34-1.10	0.6	0.32-1.12	0.35	0.15-0.85
Number of sexual partners in last year	None	0.03	0.01-0.07	0.02	0.01-0.07	0.02	0.00-0.08
	One	1		1		1	
	Two or more	1.46	0.20-10.53	1.69	0.23-12.24	2.21	0.30-16.05
	Don't know	0.73	0.35-1.53	0.78	0.36-1.67	0.28	0.08-0.95
Had a casual partner in last year	No	1		1		1	
	Yes	13.7	2.80-67.03	13.65	2.71-68.87	14.92	2.83-78.62
	Don't know	1.96	0.94-4.06	2.09	0.98-4.43	0.75	0.22-2.55
Frequency of condom use with spouse	Consistent	*	*	*	*	*	*
	Inconsistent	42.97	12.81-144.19	31.08	8.62-112.05	31.57	8.47-117.73
	Never	6.73	3.83-11.84	6.79	3.76-12.29	5.6	2.95-10.63
	No spouse	1		1		1	
	Don't know	6.14	2.64-14.27	6.33	2.64-15.20	1.97	0.53-7.36
Frequency condom use with regular partner^β	Consistent	1.94	0.17-21.62	2.27	0.20-25.31	3.06	0.27-34.32
	Inconsistent	6.46	1.52-27.55	6.04	1.33-27.55	8.16	1.78-37.44
	Never	2.22	0.63-7.74	2.59	0.74-9.07	3.5	0.99-12.33
	No regular partner	1		1		1	
	Don't know	1.94	0.93-4.03	2.08	0.98-4.42	0.77	0.22-2.62

* Too few data to calculate OR, ^β First reported regular partner among those with more than one

Table 4.7 Sensitivity analyses assessing crude ORs for ANC-HTC use among women using datasets with PPV 68.9%, 75.0% and 85.0%

		PPV 68.9%		PPV 78.5%		PPV 85.0%	
		cOR	95% CI	cOR	95% CI	cOR	95% CI
Age	15-24	1		1		1	
	25-34	1.67	0.86-3.24	1.62	0.83-3.16	1.9	0.89-4.05
	35-44	1.41	0.62-3.21	1.45	0.63-3.31	1.73	0.69-4.38
	45-54	0.44	0.11-1.72	0.45	0.11-1.78	0.64	0.14-2.91
Area of residence	Rural	1		1		1	
	Roadside	5.47	2.55-11.73	5.48	2.55-11.77	7.95	3.51-18.02
	Trading Centre	1.94	0.91-4.11	1.87	0.87-3.98	1.9	0.79-4.58
Education	None	1		1		1	
	Primary 1-4	1.94	0.50-7.56	1.84	0.47-7.25	1.09	0.22-5.30
	Primary 5-7	1.17	0.64-2.14	1.17	0.64-2.16	1.01	0.52-1.97
	Secondary or higher	0.4	0.12-1.26	0.41	0.13-1.32	0.41	0.11-1.51
Religion	Catholic	1		1		1	
	Other Christian	1.1	0.61-2.00	1.13	0.62-2.05	1.07	0.55-2.05
	Traditional	0.58	0.20-1.68	0.62	0.21-1.78	0.42	0.12-1.56
	Muslim	3.63	0.43-30.99	3.84	0.45-32.84	2.55	0.25-25.86
Marital status	Never married	0.35	0.15-0.83	0.37	0.16-0.87	0.26	0.09-0.78
	Married monogamous	1		1		1	
	Married polygamous	0.52	0.22-1.22	0.55	0.23-1.28	0.68	0.27-1.69
	Widowed	-	-	-	-	-	-
	Separated/divorced	0.58	0.16-2.13	0.5	0.13-1.95	0.85	0.22-3.32
HIV status	Negative	1		1		1	
	<3 years since first positive research test	0.74	0.12-4.56	0.78	0.13-4.75	0.87	0.12-6.33
	≥3 years since first positive research test	0.99	0.09-11.13	1.04	0.09-11.61	1.74	0.15-19.56
Reported any previous HCT	No	1		1		1	
	Yes	2.94	1.46-5.92	3.13	1.55-6.32	3.05	1.43-6.48
Spouse HIV & VCT use status at Sero6	No spouse identified	1		1		1	
	Spouse HIV neg no VCT	2.9	1.14-7.39	2.8	1.09-7.18	3.62	1.35-9.70
	Spouse HIV pos no VCT	0.62	0.04-10.11	0.65	0.04-10.52	-	-
	Spouse HIV neg used VCT	2.49	0.89-6.95	2.59	0.92-7.24	3.2	1.08-9.44
	Spouse HIV pos used VCT	*	*	*	*	*	*
Has an HIV positive relative	No	1		1		1	
	Yes	1.05	0.50-2.21	1.05	0.49-2.22	1.22	0.54-2.73
	Don't know	0.17	0.06-0.46	0.14	0.05-0.42	0.1	0.02-0.45
Age at first sex	<15	0.79	0.22-2.78	0.82	0.23-2.91	0.77	0.18-3.18
	≥15	1		1		1	
	Don't know	0.36	0.14-0.95	0.38	0.14-1.00	0.31	0.09-1.02
Number of sexual partners in last year	None	0.88	0.16-4.93	0.92	0.16-5.15	1.57	0.28-8.85
	One	1		1		1	
	Two or more	0.44	0.12-1.57	0.46	0.13-1.64	0.78	0.22-2.83
	Don't know	0.19	0.05-0.75	0.2	0.05-0.79	0.11	0.01-0.94
Had a casual partner in last year	No	1		1		1	
	Yes	2.91	0.63-13.39	3.05	0.66-14.00	2.45	0.48-12.54
	Don't know	0.21	0.05-0.83	0.22	0.05-0.87	0.12	0.01-0.97

* Too few data to calculate OR

5 Paper B. Low rates of repeat HIV testing despite increased availability of antiretroviral therapy in rural Tanzania: findings from 2003-2010

Introduction to the paper

TasP strategies advocate regular repeat testing among high-risk HIV-negative individuals in order to identify new HIV infections soon after sero-conversion (30, 82). Paper A showed that in Kisesa, walk-in facility-based HTC (WI-HTC) seemed most likely to attract high-risk individuals compared to community outreach HTC (CO-HTC) or antenatal testing of pregnant women (ANC-HTC). Paper B (published in PLOS ONE) builds on these analyses by exploring rates of repeat CO-HTC use¹ among individuals attending sero-surveys between 2003 and 2010, and compares these to rates of repeat testing when reported HTC use outside of sero-surveys is taken into account. Risk factors for repeat CO-HTC use are also investigated among individuals who attended both Sero5 in 2006-2007 and Sero6 in 2010 and who used the CO-HTC service at Sero5 (i.e. were at risk of using CO-HTC again at Sero6). This denominator was chosen in order to ensure a comparable time period during which participants might have repeat tested, due to availability of HIV-status at the time of testing for all participants (HIV-status at time of testing unknown for some participants with reported prior HTC use) and due to variability in the accuracy of reporting of previous HTC use. The socio-demographic, behavioural and clinical risk factors for repeat CO-HTC use are investigated based on risk factors previously found to be associated with HTC use in Kisesa (42, 43) as well as factors known to be associated with the risk of HIV acquisition, such as greater numbers of sexual partners (37) and unprotected sex (38). The association between HIV sero-conversion and repeat testing is also explored, as this is important to understand given that repeat testing is advocated as a mechanism to enable timely diagnosis of HIV.

¹ Referred to in the paper as the sero-survey VCT service

RESEARCH PAPER COVER SHEET

PLEASE NOTE THAT A COVER SHEET MUST BE COMPLETED FOR EACH RESEARCH PAPER INCLUDED IN A THESIS.

SECTION A – Student Details

Student	Caoimhe Cawley
Principal Supervisor	Alison Wringe
Thesis Title	Understanding the role of HIV testing and counselling services in HIV prevention in rural Tanzania

If the Research Paper has previously been published please complete Section B, if not please move to Section C

SECTION B – Paper already published

Where was the work published?	PLoS ONE		
When was the work published?	April 2013		
If the work was published prior to registration for your research degree, give a brief rationale for its inclusion	N/A		
Have you retained the copyright for the work?*	Yes	Was the work subject to academic peer review?	Yes

(see Appendix 11.4.1)

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SECTION C – Prepared for publication, but not yet published

Where is the work intended to be published?	
Please list the paper's authors in the intended authorship order:	
Stage of publication	Choose an item.

SECTION D – Multi-authored work

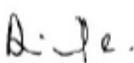
For multi-authored work, give full details of your role in the research included in the paper and in the preparation of the paper. (Attach a further sheet if necessary)	I extracted, merged and cleaned the data, designed and conducted the data analyses and wrote the manuscript for this paper.
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Student Signature:



Date: 14/04/2015

Supervisor Signature:



Date: 14/04/2015

5.1 Abstract

Background: HIV testing and counselling (HTC) services can play an important role in HIV prevention by encouraging safe sexual behaviours and linking HIV-infected clients to antiretroviral therapy (ART). However, regular repeat testing by high-risk HIV-negative individuals is important for timely initiation of ART as part of the 'treatment as prevention' approach.

Aim: To investigate HTC use during a round of HIV serological surveillance in northwest Tanzania in 2010, and to explore rates of repeat testing between 2003 and 2010.

Methods: HTC services were provided during the fourth, fifth and sixth rounds of serological surveillance in 2003-2004 (Sero4), 2006-2007 (Sero5) and 2010 (Sero6). HTC services have also been available at a government-run health centre and at other clinics in the study area since 2005. Questionnaires administered during sero-surveys collected information on socio-demographic characteristics, sexual behaviour and reported previous use of HTC services.

Results: The proportion of participants using HTC increased from 9.4% at Sero4 to 16.6% at Sero5 and 25.5% at Sero6. Among participants attending all three sero-survey rounds (n=2,010), the proportions using HTC twice or more were low, with 11.1% using the HTC service offered at sero-surveys twice or more, and 25.3% having tested twice or more if reported use of HTC outside of sero-surveys was taken into account. In multivariable analyses, individuals testing HIV-positive were less likely to repeat test than individuals testing HIV-negative (aOR 0.17, 95% CI 0.006-0.52).

Discussion/Conclusions: Although HTC service use increased over time, it was disappointing that the proportions ever testing and ever repeat-testing were not even larger, considering the increasing availability of HTC and ART in the study area. There was some evidence that HIV-negative people with higher risk sexual behaviours were most likely to repeat test, which was encouraging in terms of the potential to pick-up those at greatest risk of HIV-infection.

5.2 Introduction

HIV testing and counselling (HTC) services have recently expanded rapidly in sub-Saharan Africa in order to facilitate access to HIV treatment and care (148). It has also been widely assumed that HTC services play an important role in HIV prevention, by motivating both HIV-negative and HIV-positive individuals to reduce sexual risk taking and adopt preventive behaviours (20, 154). The contribution of HTC to HIV prevention may potentially acquire a further role in light of the treatment as prevention (TasP) approach, which suggests that widespread use of antiretroviral therapy (ART) could have a substantial impact in reducing rates of HIV transmission as a result of reduced viral loads in treated patients (30, 155, 156). One modelling study suggested that regular testing for all adults aged 15 and over once per year, followed by immediate access to treatment for those testing positive, could result in the near elimination of HIV in generalised epidemic settings within 50 years (30). However, this assertion has been challenged by other authors (157).

Despite increases in the numbers of individuals accessing HIV testing and treatment services, the World Health Organisation reported in 2011 that knowledge of HIV status remains broadly inadequate. In six countries with results from population-based surveys conducted in 2007-2009, the proportion of respondents unaware of their HIV-positive status ranged from about 30% in Kenya to almost 70% in the Congo (148). Only a few studies have investigated rates of repeat testing in sub-Saharan Africa (83-85, 88), with just two of these being carried out since ART has become more widely and freely available (85, 88). In terms of eventual TasP implementation, it would be particularly important that individuals initially testing HIV-negative but who are at high risk of sero-conversion (for example as a result of high risk sexual behaviour) come back to test on a regular basis.

This paper reports on the uptake of HTC services during the latest round of HIV serological surveillance carried out in 2010 as part of an on-going community cohort study in Kisesa in northwest Tanzania. It also reports on repeat use of HTC services over consecutive rounds of serological surveillance carried out between 2003 and 2010; a period of time which saw a number of changes in terms of the availability of HIV services, including the commencement of a national ART programme at the start of 2005, and the opening of a permanent HTC clinic in the study area later that

year. We explore how these changes affected rates of first time and repeat HTC over time.

5.3 Methods

5.3.1 Ethical statement

Ethical approval for each survey round of the Kisesa cohort study has been granted by the Tanzanian Medical Research Coordinating Committee and the Ethics Committee of the London School of Hygiene and Tropical Medicine. During the 2003-2004 survey, verbal consent was obtained directly from all study participants including those aged 15-17, due to low literacy rates among the study population. Consent was witnessed and documented for each study participant on their survey questionnaire, by a member of the sero-survey team. During serological surveys in 2006-2007 and 2010, consent was again obtained directly from all study participants including those aged 15-17, however the option of written consent was introduced, for those who were able to provide this. Although data from the subsequent serological survey in 2012-2013 are not used in this paper, it was recommended by the review committee that additional written consent be obtained from parents or guardians for participants aged 15-17 for this round, and this was implemented accordingly.

5.3.2 Study setting

The study setting in Mwanza region has been described in detail by Mwaluko *et al* (142). Briefly, the study area lies approximately 20km to the east of Mwanza city and consists of six villages which make up the administrative ward of Kisesa, with a combined population of approximately 32,000 people. Some sub-villages lie along the main tarmac road which cuts through the study area and leads to the border with Kenya, while other sub-villages are located further away from the road in rural areas. The largest village in the study area, Kisesa trading centre, lies directly along the main road.

Since 1994, 27 rounds of demographic surveillance and six HIV serological surveys have been completed. Demographic surveillance took place approximately once every six months, collecting information on residence and survival status of all

household members, pregnancy among women of reproductive age, and births and migration. Eligibility and invitations for the serological surveys (sero-surveys) were prepared based on having been resident at the last round of demographic surveillance and being aged 15 or older at the time of the sero-survey. Venous blood was collected from all consenting participants during the first sero-survey in 1994/1995, while finger prick blood was collected during all subsequent sero-surveys. Samples were tested for HIV anonymously at the National Institute for Medical Research (NIMR) in Mwanza.

A separate and confidential HTC service was provided in temporary village based facilities during the fourth, fifth and sixth rounds of serological surveillance in 2003-2004 (Sero4), 2006-2007 (Sero5) and 2010 (Sero6), for those wishing to know their HIV status (see below for further details). Height and weight measurements were taken during sero-surveys, accompanied by a detailed questionnaire. The questionnaire was administered by same sex interviewers and included items on socio-demographic characteristics, sexual behaviour, health status and previous HTC service use. All study participants were additionally offered free medical treatment for any health problems present at the time of the sero-survey.

5.3.3 HIV testing and counselling and other health services

The study population is served by a government-run health centre located in Kisesa trading centre, by three small government-run dispensaries located in the rural villages, and by a number of private clinics located mainly in the trading centre. HTC services are distinguished as those provided at stand-alone voluntary counselling and testing (VCT) clinics, or via other clinics within a hospital or health centre (usually at antenatal, sexually transmitted infection or tuberculosis clinics), referred to as provider initiated testing and counselling (PITC). A stand-alone VCT clinic opened at Kisesa health centre in 2005, while PITC has been offered to all pregnant women attending the health centre antenatal clinic (ANC) since the end of 2008. PITC has also been available at the out-patients department since 2010, where testing may be offered to patients attending the sexually transmitted infection and tuberculosis clinics. Since mid-2009, antenatal PITC is usually offered at the small rural dispensaries, dependant on the availability of test-kit supplies.

When HTC services were first provided in Kisesa in 2005, patients testing HIV-positive were referred to Mwanza city hospitals, where free care and treatment services have been available under the national ART programme since the beginning of 2005. At the end of 2008, ART services became available locally at a Care and Treatment Centre (CTC) at Kisesa health centre. At this point, individuals testing HIV-positive were referred to Kisesa CTC for care, while patients already attending Mwanza city hospitals were given the option of transferring to Kisesa CTC if they wished.

Since the fourth sero-survey round in 2003-2004, a separate and temporary VCT clinic has been available to all sero-survey participants wishing to know their HIV status. After their questionnaire interview, individuals expressing desire for VCT were directed to a separate purpose-constructed hut for pre-test counselling with a trained counsellor. At Sero4 venous blood was collected and transported to the NIMR laboratory for HIV testing, and clients were asked to return for their test results and post-test counselling one week later (42). During Seros 5 and 6, venous blood was again collected but rapid HIV screening tests were used; results and post-test counselling were usually delivered within 45 minutes of the test being performed (43). Individuals testing HIV-positive at Sero4 were informed that treatment would become available in the near future through the national ART programme. With their prior agreement, these individuals were subsequently traced by the VCT counsellors and referred to the zonal referral hospital in Mwanza. Individuals testing HIV-positive at Sero5 were referred directly to Mwanza city hospitals, while those testing positive at Sero6 were referred to the local Kisesa CTC.

5.3.4 Data and analysis

All survey data were double entered. Linking of demographic data, sero-survey interview data, HIV research tests and sero-survey VCT attendance was carried out anonymously using study identification numbers. Sexual behaviour variables collected during sero-survey interviews included age at first sex, number of sexual partners and frequency of condom use with different partner types. Marital change and spouse identification variables were obtained from the demographic data, after which spouses' HIV-status was anonymously linked in from the serological data. The percentage change in body mass index (BMI) at each sero-survey was

calculated using height and weight data collected at the previous sero round, for those who had attended the previous sero-survey.

At Seros 4, 5 and 6, the survey questionnaire also captured information on participants' self-reported prior use of HTC services, including VCT use at various other clinics within and outside the study area (e.g. Kisesa health centre VCT, 'Angaza' VCT clinics run by the African Medical Research Foundation, other temporary mobile VCT clinics provided occasionally in the study area by non-governmental organisations or regional hospitals), and via PITC at antenatal clinics and/or hospital outpatient departments. At Seros 5 and 6, it was possible to additionally identify those with known prior use of VCT at an earlier sero-survey round, for those who had attended an earlier round.

All statistical analyses were done using Stata 12 (StataCorp LP, Texas, USA). In order to ensure that all individuals had an equal period of time during which they might have repeat tested, a repeat tester was defined as somebody who attended both Sero5 and Sero6 and who used the VCT service available at each of these rounds. Univariable analyses were used to describe associations between all variables of interest and i) uptake of VCT at the Sero6 round, ii) repeat use of VCT at the Sero5 and Sero6 rounds. Logistic regression models were fitted to identify characteristics independently associated with VCT uptake using a forward-fitting approach and including all variables significant in univariable analyses at the $p \leq 0.10$ level. Likelihood ratio tests were used to assess the inclusion of variables in multivariable models.

5.4 Results

5.4.1 Factors associated with VCT use at Sero6

Altogether 8,008 individuals attended the Sero6 round, of whom 60.9% were women. In total 31.7% of men and 30.5% of women gave consent to use VCT, while 25.9% of men and 25.2% of women subsequently went for VCT. This represents approximately a doubling in the proportion of men using VCT since Sero4, and a threefold increase amongst women (Table 5.1).

Table 5.1 shows trends in the factors most strongly associated with uptake of VCT at Seros 4, 5 and 6 in univariable analyses. (Previous analyses of factors associated with VCT uptake at Seros 4 and 5 have been published by Wringe *et al* (42) and by Isingo *et al* (43). The analyses were updated and provided in Table 5.1 for context). These included having previously used an HTC service, having a spouse who used VCT during that sero-survey round, area of residence (those living in roadside villages or in the trading centre being more likely to use VCT compared to those living in rural villages) and level of education (those with most education being most likely to use VCT). In addition, those who were HIV-positive were more likely to test compared to HIV-negatives, except at Sero6, when HIV-positive women were *less* likely to test than HIV-negative women (odds ratio [OR] 0.77, 95% confidence intervals [CI] 0.59-1.00).

Table 5.1 Selected factors associated with uptake of VCT at Seros 4, 5 and 6 among men and women

		Sero 4			Sero 5			Sero 6		
		No.	% using VCT	OR (95% CI)	No.	% using VCT	OR (95% CI)	No.	% using VCT	OR (95% CI)
MEN - Total		3,978	12.1		3,633	18.3		3,131	25.9	
Area of residence	Rural	2,109	10.3	1	2,052	16.7	1	1,772	15.8	1
	Roadside	991	11.9	1.18 (0.93-1.49)	940	20.7	1.31 (1.08-1.59)*	763	36.3	3.04 (2.50-3.69)*
	Trading Centre	878	16.7	1.75 (1.40-2.20)*	641	19.8	1.24 (0.99-1.55) [¶]	596	42.8	3.98 (3.24-4.90)*
Education	None	623	4.0	0.26 (0.17-0.39)*	670	13.0	0.62 (0.48-0.80)*	453	18.1	0.61 (0.47-0.79)*
	Primary 1-4 years	794	9.2	0.62 (0.48-0.81)*	445	14.8	0.73 (0.55-0.97)*	324	25.3	0.93 (0.71-1.23)
	Primary 5-7 years	2,216	14.0	1	1,966	19.3	1	1,563	26.7	1
	Secondary or higher	344	21.1	1.63 (1.23-2.17)*	546	24.0	1.32 (1.05-1.65)*	777	29.1	1.13 (0.93-1.36)
HIV status	Negative	3,709	11.8	1	3,445	17.8	1	2,947	25.9	1
	Positive	213	17.8	1.63 (1.13-2.35)*	173	28.3	1.83 (1.30-2.58)*	161	28.0	1.11 (0.78-1.58)
Previous HTC use ^α	No	3,893	11.5	1	3,077	15.2	1	2,215	18.2	1
	Yes	85	38.8	4.87 (3.11-7.62)*	552	35.7	3.1 (2.54-3.79)*	916	44.7	3.63 (3.06-4.30)*
Spouse HIV status & VCT use ^Δ	No spouse identified	2,792	11.8	1	2,580	16.4	1	2,444	24.9	1
	HIV neg, no VCT	1,064	9.9	0.81 (0.65-1.03) [¶]	829	17.6	1.09 (0.89-1.34)	484	19.4	0.73 (0.57-0.93)*
	HIV pos, no VCT	37	13.5	1.16 (0.45-3.00)	41	24.4	1.64 (0.80-3.38)	29	31.0	1.36 (0.62-3.00)
	HIV neg, used VCT	70	48.6	7.03 (4.34-11.38)*	162	49.4	4.97 (3.59-6.89)*	163	58.3	4.22 (3.05-5.84)*
	HIV pos, used VCT	6	83.3	37.2 (4.33-319.36)*	13	30.8	2.27 (0.69-7.39)	10	60.0	4.53 (1.27-16.10)*
WOMEN - Total		4,982	7.4		5,063	15.3		4,877	25.2	
Area of residence	Rural	2,404	5.0	1	2,631	12.4	1	2,493	14.0	1
	Roadside	1,312	9.1	1.91 (1.47-2.49)*	1,303	19.3	1.69 (1.41-2.02)*	1,284	34.7	3.27 (2.78-3.84)*
	Trading Centre	1,266	10.2	2.17 (1.68-2.82)*	1,128	17.6	1.5 (1.24-1.82)*	1,100	39.5	4.02 (3.40-4.74)*
Education	None	1,661	2.4	0.21 (0.15-0.30)*	1,972	10.6	0.53 (0.44-0.63)*	1,831	17.7	0.5 (0.43-0.58)*
	Primary 1-4 years	786	7.1	0.68 (0.50-0.92)*	425	15.8	0.83 (0.62-1.10)	314	28.3	0.92 (0.71-1.20)
	Primary 5-7 years	2,338	10.1	1	2,288	18.4	1	2,212	30.1	1
	Secondary or higher	196	18.4	2 (1.36-2.94)*	370	20.5	1.14 (0.87-1.50)	510	28.6	0.93 (0.75-1.15)
HIV status	Negative	4,653	7.1	1	4,690	15.0	1	4,502	25.5	1
	Positive	277	11.6	1.7 (1.15-2.49)*	341	20.8	1.49 (1.13-1.96)*	359	20.9	0.77 (0.59-1.00) [¶]
Previous HTC use ^α	No	4,919	7.2	1	4,467	13.4	1	2,921	17.3	1
	Yes	63	22.2	3.69 (2.02-6.74)*	592	30.4	2.83 (2.33-3.44)*	1,956	36.9	2.8 (2.45-3.20)*
Spouse HIV status & VCT use ^Δ	No spouse identified	3,769	7.6	1	3,971	15.0	1	4,180	25.3	1
	HIV neg, no VCT	994	3.9	0.5 (0.35-0.70)*	782	10.9	0.69 (0.54-0.88)*	450	14.0	0.48 (0.37-0.63)*
	HIV pos, no VCT	48	6.3	0.81 (0.25-2.62)	56	14.3	0.94 (0.44-2.00)	37	16.2	0.57 (0.24-1.38)
	HIV neg, used VCT	140	25.0	4.05 (2.71-6.05)*	227	34.8	3.02 (2.26-4.02)*	196	49.5	2.9 (2.17-3.87)
	HIV pos, used VCT	15	26.7	4.42 (1.40-13.96)*	22	36.4	3.23 (1.35-7.73)*	9	44.4	2.37 (0.63-8.83)

¶ Figures for VCT uptake at Seros 4 and 5 reflect an update on previous figures presented by Wringe *et al* (42) and Isingo *et al* (43). The figures are provided here for context

*p≤0.05, [¶]p≤0.1

^α Reported or documented (at an earlier sero-survey round) previous HTC use

^Δ Spouse's HIV status & VCT use at current sero-survey round

A full analysis of the associations between socio-demographic, clinical and behavioural characteristics and VCT use at Sero6 can be seen in Table 5.2 and Table 5.3. Similar factors to those mentioned above persisted as independent predictors of VCT use at the Sero6 round. Among men, these included previous HTC use (adjusted odds ratio [aOR]: 2.30, 95% CI 1.88-2.81), having a spouse who used VCT at Sero6 (aOR HIV-negative spouse using VCT: 2.90, 95% CI 1.93-4.36; aOR HIV-positive spouse using VCT: 4.31, 95% CI 1.08-17.26), and area of residence (aOR those living in trading centre compared to rural villages: 3.24, 95% CI 2.55-4.12; aOR those living in roadside compared to rural villages: 2.57, 95% CI 2.07-3.19). Similar factors were independently associated with VCT use among women (Table 5.2 and Table 5.3) with the addition of level of education; women with no education were significantly less likely to use VCT compared to those with 5-7 years of primary education (aOR 0.67, 95% CI 0.55-0.80).

In contrast to earlier rounds, women who were HIV-positive at Sero6 were significantly *less* likely to use VCT compared to HIV-negative women (Table 5.3: aOR 0.46, 95% CI 0.34-0.61). A similar trend was seen among men, although the result was not statistically significant (aOR 0.72 95% CI 0.47-1.09). A closer investigation revealed an interaction between HIV status and previous HTC use. HIV-positive individuals were more likely to use VCT if they had *not* previously used any HTC service (OR men: 1.62, 95% CI 0.99-2.64; OR women: 1.16, 95% CI 0.77-1.75) but not if they *had* previously used HTC (OR men: 0.51, 95% CI 0.30-0.85; OR women: 0.45, 95% CI 0.32-0.63).

Table 5.2 Crude and adjusted odds ratios for socio-demographic factors associated with VCT uptake at Sero6

		Males				Females			
		No.	% using VCT	OR (95% CI)	aOR (95% CI) [‡]	No.	% using VCT	OR (95% CI)	aOR (95% CI) [‡]
Total		3,131	25.9			4,877	25.2		
Age	15-24	1,503	19.8	1	1	1,722	23.5	1	1
	25-34	464	37.1	2.39 (1.91-3.00)*	1.09 (0.75-1.59)	1,125	32.4	1.56 (1.32-1.84)*	1.03 (0.83-1.29)
	35-44	412	35.9	2.28 (1.79-2.89)*	1.17 (0.76-1.80)	811	31.2	1.47 (1.22-1.78)*	1.15 (0.90-1.47)
	>=45	751	26.0	1.42 (1.16-1.75)*	0.83 (0.54-1.27)	1,219	16.8	0.66 (0.55-0.79)*	0.83 (0.62-1.11)
Area of residence	Rural	1,772	15.8	1	1	2,493	14.0	1	1
	Roadside	763	36.3	3.04 (2.50-3.69)*	2.57 (2.07-3.19)*	1,284	34.7	3.27 (2.78-3.84)*	2.95 (2.45-3.54)*
	Trading Centre	596	42.8	3.98 (3.24-4.90)*	3.24 (2.55-4.12)*	1,100	39.5	4.02 (3.40-4.74)*	3.39 (2.78-4.15)*
Ethnicity	Sukuma	2,961	24.7	1	1	4,564	24.4	1	1
	Non Sukuma	168	47.6	2.77 (2.02-3.79)*	1.67 (1.16-2.40)*	306	37.3	1.84 (1.45-2.35)*	
Education	None	453	18.1	0.61 (0.47-0.79)*		1,831	17.7	0.5 (0.43-0.58)*	0.67 (0.55-0.80)*
	Primary 1-4 years	324	25.3	0.93 (0.71-1.23)		314	28.3	0.92 (0.71-1.20)	0.88 (0.66-1.19)
	Primary 5-7 years	1,563	26.7	1		2,212	30.1	1	1
	Secondary & higher	777	29.1	1.13 (0.93-1.36)		510	28.6	0.93 (0.75-1.15)	1.00 (0.74-1.34)
Religion	Catholic	1,107	28.2	1		2,062	26.0	1	
	Other Christian	1,416	27.0	0.94 (0.79-1.13)		2,433	25.0	0.95 (0.83-1.08)	
	Traditional	530	15.8	0.48 (0.37-0.63)*		253	12.3	0.4 (0.27-0.58)*	
	Muslim	75	44.0	2 (1.25-3.22)*		117	42.7	2.12 (1.45-3.10)*	
Marital status	Never Married	1,466	20.1	1	1	1,008	18.3	1	1
	Married monogamous	1,325	31.5	1.83 (1.54-2.17)*	0.69 (0.44-1.08)	2,448	29.4	1.86 (1.55-2.23)*	0.96 (0.70-1.32)
	Marries polygamous	128	37.5	2.38 (1.63-3.48)*	0.97 (0.51-1.85)	402	29.6	1.88 (1.44-2.46)*	1.07 (0.72-1.58)
	Widowed	46	13.0	0.6 (0.25-1.42)	0.43 (0.16-1.18) [‡]	512	13.1	0.67 (0.50-0.91)*	0.66 (0.42-1.04) [‡]
	Separated/Divorced	97	33.0	1.95 (1.26-3.04)*	0.99 (0.53-1.88)	464	28.0	1.74 (1.35-2.26)*	1.2 (0.81-1.78)
Marital status change	No	2,479	23.5	1	1	3,142	22.7	1	
	Yes	266	31.2	1.48 (1.12-1.95)*	1.1 (0.77-1.57)	741	26.7	1.24 (1.03-1.49)*	
	Don't know	386	38.1	2 (1.60-2.51)*	1.7 (1.21-2.39)*	994	31.7	1.58 (1.35-1.85)*	

*p≤0.05, [‡]p≤0.1

[‡] Adjusted for all socio-demographic, clinical & behavioural factors associated with VCT use in univariable analyses (p≤0.10) and remaining significant in multivariable analyses

Table 5.3 Crude and adjusted odds ratios for clinical and behavioural factors associated with VCT uptake at Sero6

		Males				Females			
				% using				% using	
		No.	VCT	OR (95% CI)	aOR (95% CI) ^γ	No.	VCT	OR (95% CI)	aOR (95% CI) ^γ
HIV status	Negative	2,947	25.9	1	1	4,502	25.5	1	1
	Positive	161	28.0	1.11 (0.78-1.58)	0.72 (0.47-1.09)	359	20.9	0.77 (0.59-1.00) [¶]	0.46 (0.34-0.61)*
BMI loss	None	931	26.9	1	1	1,506	21.8	1	1
	<5%	240	28.7	1.1 (0.80-1.51)	1.01 (0.70-1.45)	347	21.3	0.97 (0.73-1.29)	1.1 (0.81-1.51)
	>= 5%	144	18.1	0.6 (0.38-0.94)*	0.55 (0.34-0.91)*	350	20.9	0.94 (0.71-1.25)	1.07 (0.78-1.47)
	Unknown	1,816	25.7	0.94 (0.79-1.13)	1.09 (0.88-1.35)	2,674	28.1	1.4 (1.20-1.62)*	1.64 (1.37-1.96)*
Previous HTC use ^α	No	2,215	18.2	1	1	2,921	17.3	1	1
	Yes	916	44.7	3.63 (3.06-4.30)*	2.30 (1.88-2.81)*	1,956	36.9	2.8 (2.45-3.20)*	1.57 (1.33-1.85)*
Spouse HIV status & VCT use ^Δ	No spouse identified	2,444	24.9	1	1	4,180	25.3	1	1
	HIV neg, no VCT	484	19.4	0.73 (0.57-0.93)*	0.71 (0.51-0.98)*	450	14.0	0.48 (0.37-0.63)*	0.55 (0.40-0.74)*
	HIV pos, no VCT	29	31.0	1.36 (0.62-3.00)	1.09 (0.44-2.73)	37	16.2	0.57 (0.24-1.38)	0.69 (0.28-1.74)
	HIV neg, used VCT	163	58.3	4.22 (3.05-5.84)*	2.90 (1.93-4.36)*	196	49.5	2.9 (2.17-3.87)*	2.17 (1.57-3.00)*
	HIV pos, used VCT	10	60.0	4.53 (1.27-16.10)*	4.31 (1.08-17.26)*	9	44.4	2.37 (0.63-8.83)	2.7 (0.66-11.07)
Age at first sex	≥15	1,782	33.5	1	1	3,431	30.0	1	1
	<15	256	21.5	0.54 (0.40-0.74)*	0.66 (0.47-0.94)*	467	20.6	0.6 (0.48-0.77)*	0.73 (0.56-0.95)*
	Never had sex	825	11.2	0.25 (0.20-0.32)*	0.25 (0.17-0.36)*	612	8.7	0.22 (0.17-0.30)*	0.51 (0.10-2.68)
	Don't know	237	27.4	0.75 (0.55-1.01) [¶]	0.78 (0.55-1.10)	337	13.9	0.38 (0.28-0.52)*	0.59 (0.41-0.83)*
No. of sex partners last year	None or one	1,650	29.5	1		4,130	27.2	1	1
	Two	398	36.2	1.36 (1.08-1.71)*		76	46.1	2.28 (1.44-3.60)*	1.99 (1.19-3.31)*
	Three or more	247	36.4	1.37 (1.04-1.82)*		24	37.5	1.6 (0.70-3.67)	1.21 (0.47-3.13)
Frequency of condom use ^Ω	Never use	1,348	30.9	1	1	2,719	28.5	1	1
	Inconsistent	304	43.8	1.74 (1.35-2.25)*	1.21 (0.91-1.63)	532	41.9	1.81 (1.50-2.20)*	1.17 (0.93-1.47)
	Consistent	86	36.0	1.26 (0.80-1.99)	0.84 (0.49-1.45)	48	31.3	1.14 (0.62-2.11)	0.67 (0.34-1.35)
	Never had sex	825	11.2	0.28 (0.22-0.36)*	-	612	8.7	0.24 (0.18-0.32)*	-
	Don't know	568	24.6	0.73 (0.59-0.92)*	0.72 (0.53-0.98)*	966	16.8	0.51 (0.42-0.61)*	0.71 (0.52-0.98)*
Has a relative who is HIV positive	No	2,133	24.3	1		3,478	22.6	1	1
	Yes	479	38.8	1.97 (1.60-2.43)*		1,148	34.2	1.79 (1.54-2.07)*	1.19 (0.98-1.42) [¶]
	Don't know	274	29.2	1.28 (0.97-1.69) [¶]		199	24.1	1.09 (0.78-1.52)	0.85 (0.57-1.26)
Knows somebody taking ART	No	1,523	23.4	1		3,029	22.0	1	1
	Yes	935	35.4	1.79 (1.50-2.14)*		1,515	34.5	1.87 (1.63-2.14)*	1.15 (0.96-1.37)*
	Don't know	423	22.5	0.95 (0.73-1.22)		269	13.8	0.57 (0.40-0.81)*	0.66 (0.44-0.99)*

*p≤0.05, [¶]p≤0.1

^γ Adjusted for all socio-demographic, clinical & behavioural factors associated with VCT use in univariable analyses (p≤0.10) and remaining significant in multivariable analyses

^α Reported or documented (at an earlier sero-survey round) previous HTC use, ^Δ Spouse's HIV status & VCT use at current sero-survey round

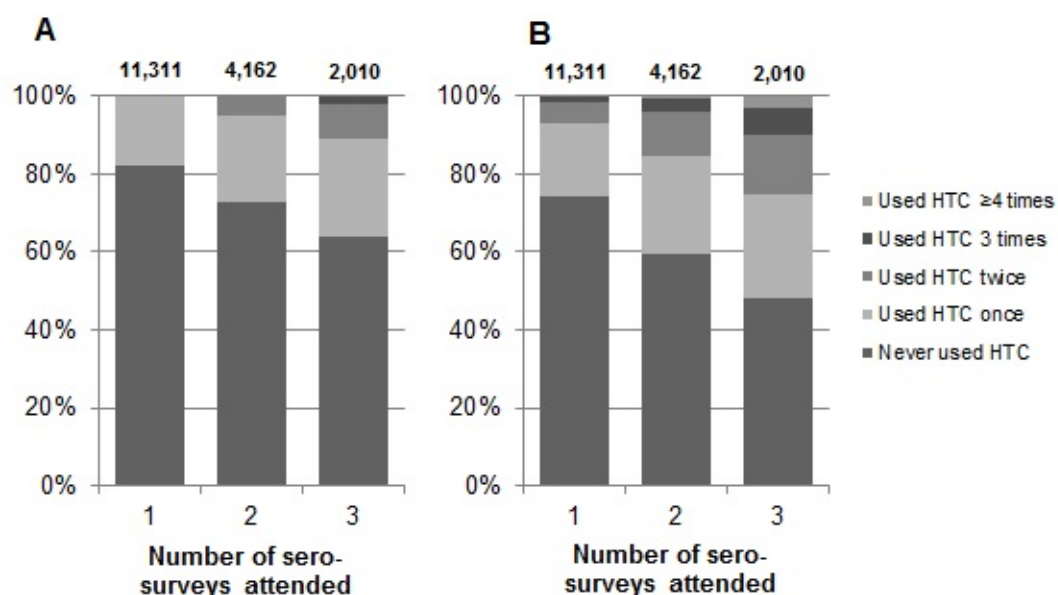
^Ω Frequency of condom use in last 12 months considering three most recent partners

5.4.2 Lifetime use of HTC services among those attending Sero4, 5 and/or 6

In total over the period 2003-2010, 17,483 individuals attended at least one of Seros 4, 5 and/or 6. Figure 5.1 shows the number of individuals attending one or more sero-surveys and the number of times A) VCT was used at a sero-survey; B) an HTC service was ever used (i.e. at sero-survey *and/or* reported use of HTC outside sero-surveys). Considering VCT use at sero-surveys only (Figure 5.1A), of those attending all 3 seros (n=2,010) 64.0% never used VCT, 24.9% used VCT once and 11.1% used VCT either two or three times. Taking into account reported use of HTC services elsewhere (Figure 5.1B), of those attending all 3 seros, 48.0% never used HTC, 26.8% used HTC once and 25.3% used HTC two or more times. In total, of all participants attending at least one sero-survey (n=17,483) and considering HTC use at sero-surveys and/or elsewhere, just 11.2% had ever tested twice or more.

Figure 5.1 Number of individuals attending one or more of Sero4, 5 and/or 6 and the number of times HTC was used.

Panel A) number of times HTC used during sero-surveys; panel B) number of times HTC ever used (i.e. during sero-surveys and/or reported use of HTC outside sero-surveys).

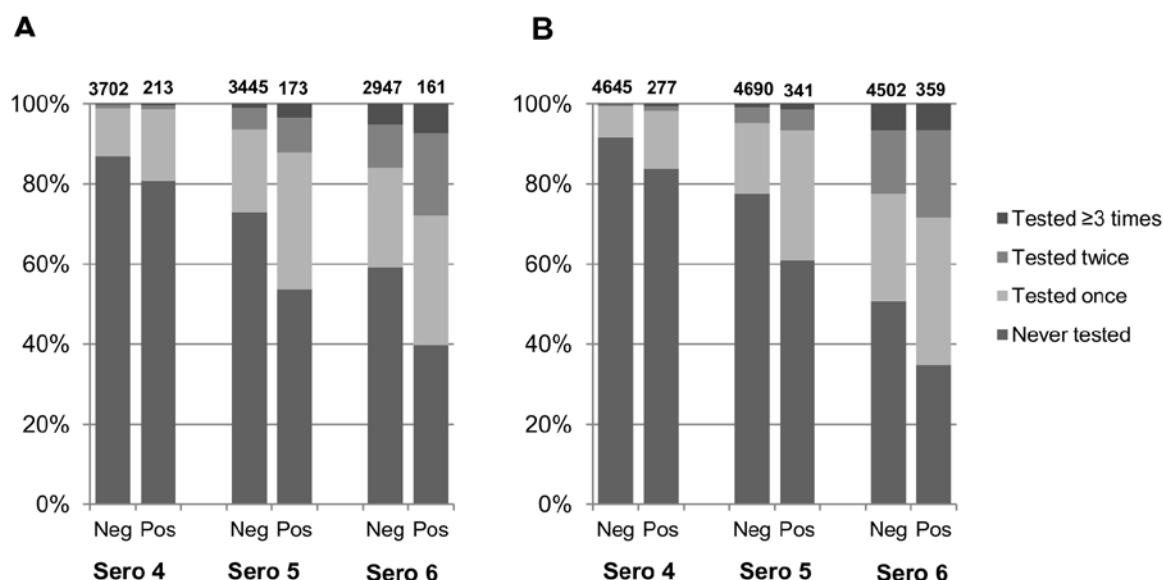


The proportion of participants who had never used any HTC service declined more rapidly over time among HIV-positive participants compared to HIV-negative. Figure 5.2 shows the proportions of men and women who had ever used HTC at sero-

surveys and/or elsewhere by the end of each sero-survey round by HIV-status, with HIV-status reflecting status at the sero-round in question rather than at any earlier test. By 2010 (Sero6), 60.2% of HIV-positive men and 65.2% of HIV-positive women had tested at least once, compared to 41.8% of HIV-negative men and 49.3% of HIV-negative women. Overall, 16.7% of men and 22.9% of women attending Sero6 had ever repeat tested (i.e. tested twice or more).

Figure 5.2 Number of times HTC was ever used (i.e. at sero-surveys and/or elsewhere) by the end of each sero-survey round by HIV status.

Panel A) men; panel B) women. (NB: HIV status reflects status at the sero-survey round in question, rather than any earlier test).



When interpreting data which includes reported as well as known or documented use of HTC services, it should be noted that there is a tendency to both over and under report previous HTC service use. Table 5.4 shows that among HIV-negative individuals, of 7,015 instances where participants attended two consecutive sero-survey rounds (either Seros 4 and 5 and/or Seros 5 and 6), in 823 instances participants reported that they had used VCT at the earlier sero-survey round. However, comparison against earlier records revealed that in only 57.6% of cases (474/823) these participants *had* actually used VCT at the earlier round, with 42.4% (349/823) giving incorrect reports. Furthermore, of 822 instances where HIV-negative individuals had *known* use of VCT an earlier sero-survey round, in 42.3%

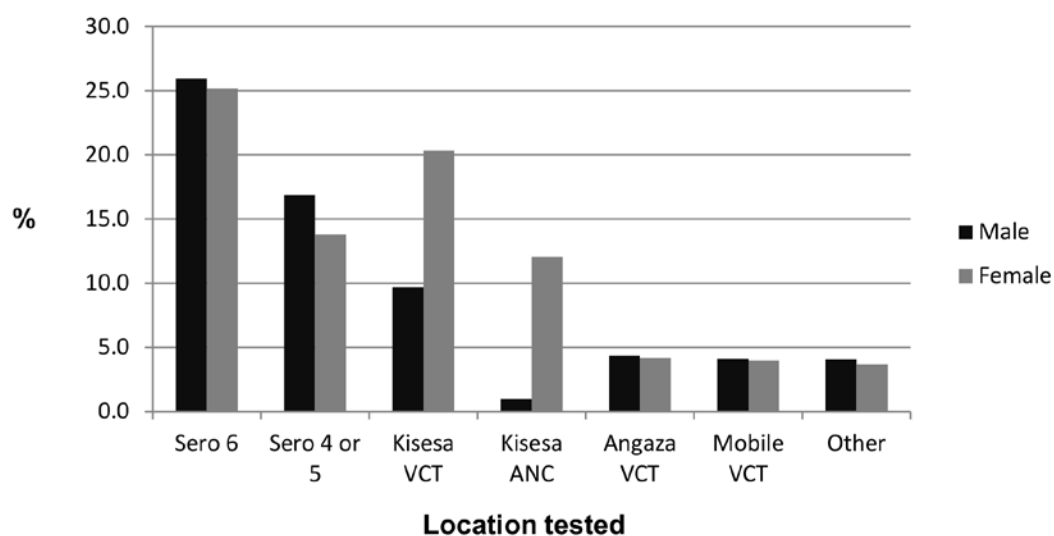
of cases (348/822) these individuals failed to report this VCT use when asked at the later sero-survey round. Similar trends were seen among HIV-positive individuals, although in an even larger proportion of cases (49/89 or 55.1%) participants incorrectly reported VCT use at an earlier sero-survey round that did not actually occur. Of 67 instances where HIV-positive individuals had *known* use of VCT at an earlier sero-survey, in 40.3% of cases (27/67) participants failed to report this VCT use at the later round.

Table 5.4 By HIV status: number of times individuals reported using VCT at an earlier sero-survey round, versus number of times VCT was actually used at the earlier round

HIV negative at later sero-survey round	Reported at Sero 5 or 6 that used VCT at Sero 4 or 5, N (%)		
	No	Yes	Total
Actually used VCT at Sero 4 or 5			
No	5844 (94.4)	349 (42.4)	6,193
Yes	348 (5.6)	474 (57.6)	822
Total	6192 (100)	823 (100)	7,015
HIV positive at later sero-survey round			
Actually used VCT at Sero 4 or 5	No	Yes	Total
No	328 (92.4)	49 (55.1)	377
Yes	27 (7.6)	40 (44.9)	67
Total	355 (100)	89 (100)	444

Figure 5.3 shows the proportion of men and women attending Sero6 who had used different HTC services. Outside of sero-surveys, the largest numbers of tests were carried out at the VCT and ANC clinics at Kisesa health centre. These clinics were used by a larger proportion of women than men. However, it is expected that only a small number of men would be tested at the ANC while attending with their partners. Smaller numbers of individuals tested at Angaza clinics in Mwanza city or elsewhere, at mobile VCT clinics and at other locations, where the proportionate use by men and women was more equal.

Figure 5.3 Among those who attended Sero 6, proportions of men (n=3,131) and women (n=4,877) using different HTC services.



5.4.3 Factors associated with repeat use of VCT

Table 5.5 shows the characteristics of individuals who attended Sero5 and used VCT at this round, and who also attended Sero6 (n=564; 234 men, 330 women). In total 321/564 participants (56.9%) used VCT at Sero5 only, while 243/564 (43.1%) used VCT again at Sero6 (i.e. repeat tested). Significantly fewer individuals who were HIV-positive at Sero5 used VCT again at Sero6 (n=5/28, 17.9%) compared to those who were HIV-negative at Sero5 (n=238/534, 44.6%). However, a smaller proportion of individuals who sero-converted between sero-surveys (i.e. HIV-negative at Sero5, HIV-positive at Sero6) used VCT again at Sero6 (n=2/7, 28.6%) compared to those who did not sero-convert (n= 240/553, 43.4%). The proportions of individuals repeat testing increased with higher risk sexual behaviours (those married polygamously, those with higher numbers of sexual partners in their lifetime or in the last 12 months, and those using condoms inconsistently), although not all of these associations were statistically significant in univariable and multivariable analyses (Table 5.5).

The factors most strongly associated with repeat testing in multivariable analyses included area of residence (aOR for trading centre compared to rural villages: 2.34, 95% CI 1.35-4.04; aOR for roadside villages compared to rural villages: 2.67, 95%

CI 1.73-4.12), being of Islamic faith (aOR for muslims compared to catholics: 9.14, 95% CI 1.88-44.47), testing HIV-negative at Sero5 (aOR for testing HIV-positive compared to HIV-negative: 0.17, 95% CI 0.006-0.52), reporting using condoms inconsistently (aOR for using condoms inconsistently compared to never using condoms: 1.78, 95% CI 1.06-3.00) and being married polygamously (aOR for those married polygamously compared to those never married: 1.73, 95% CI 0.97-3.08). Those with no education were also significantly less likely to repeat test than those with a primary level of education (aOR 0.58, 95% CI 0.34-0.98).

Table 5.5 Characteristics of individuals attending both Sero5 and Sero6 and factors associated with repeat use of VCT at each round[#]

		No.	% Repeat Testing	OR (95% CI)	aOR (95% CI)
Total		564	43.1		
Sex	Male	234	45.7	1.2 (0.86-1.69)	1.6 (1.03-2.47)*
	Female	330	41.2	1	1
Age	15-24	99	42.4	1.25 (0.76-2.08)	
	25-34	150	45.3	1.41 (0.90-2.21)	
	35-44	142	48.6	1.61 (1.03-2.53)*	
	≥45	173	37.0	1	
Area of residence	Rural	294	32.7	1	1
	Roadside	176	53.4	2.36 (1.61-3.47)*	2.67 (1.73-4.12)*
	Trading Centre	94	56.4	2.67 (1.66-4.29)*	2.34 (1.35-4.04)*
Ethnicity	Sukuma	537	43.0	1	
	non Sukuma	27	44.4	1.06 (0.49-2.31)	
Education	None	114	29.8	0.48 (0.30-0.75)*	0.58 (0.34-0.98)*
	Primary 1-4 yrs	44	36.4	0.64 (0.33-1.23)*	0.59 (0.27-1.25)
	Primary 5-7 yrs	312	47.1	1	1
	Secondary or higher	93	49.5	1.1 (0.69-1.75)	1.24 (0.67-2.27)
Religion	Catholic	256	41.4	1	1
	Other Christian	253	43.5	1.09 (0.77-1.55)	1.35 (0.91-2.01)
	Traditional	39	33.3	0.71 (0.35-1.44)	0.71 (0.31-1.65)
	Muslim	16	87.5	9.91 (2.21-44.50)*	9.14 (1.88-44.47)
Marital status	Never married	66	45.5	1.14 (0.67-1.93)	0.72 (0.30-1.70)
	Married monogamous	348	42.2	1	1
	Married polygamous	67	52.2	1.5 (0.89-2.53)	1.73 (0.97-3.08) [¶]
	Widowed	24	20.8	0.36 (0.13-0.99)*	0.45 (0.13-1.57)
	Separated/Divorced	50	44.0	1.07 (0.59-1.95)	1.45 (0.64-3.27)
Marital status change	No	373	42.1	1	
	Yes	91	39.6	0.9 (0.56-1.44)	
	Don't know	100	50.0	1.38 (0.88-2.14)	
HIV status Sero 5	Negative	534	44.6	1	1
	Positive	28	17.9	0.27 (0.10-0.72)*	0.17 (0.06-0.52)*
Seroconverted Sero 5-					
Sero6	No	553	43.4	1	
	Yes	7	28.6	0.52 (0.10-2.71)	

[#]Characteristics and behavioural variables are those reported at Sero6, unless otherwise stated

*p≤0.05, [¶]p≤0.1

Table 5.5 continued[#]

		No.	% Repeat Testing	OR (95% CI)	aOR (95% CI)
BMI loss	None	363	44.6	1	
	<5%	106	40.6	0.85 (0.55-1.31)	
	≥5%	94	40.4	0.84 (0.53-1.34)	
Sero 4 VCT use	Didn't attend Sero4	219	44.3	1.22 (0.85-1.75)	
	Attended Sero4 no VCT	263	39.5	1	
	Attended Sero4 used VCT	82	51.2	1.61 (0.97-2.64) [¶]	
Spouse HIV & VCT use ^Δ	No spouse identified	391	45.0	1	1
	Spouse HIV neg, no VCT	117	30.8	0.54 (0.35-0.84)*	0.53 (0.31-0.91)*
	Spouse HIV pos, no VCT	5	40.0	0.81 (0.13-4.93)	5.87 (0.68-50.52)
	Spouse HIV neg, used VCT	49	59.2	1.77 (0.97-3.24) [¶]	1.27 (0.64-2.55)
	Spouse HIV pos, used VCT	1	0.0	-	-
Age at first sex	≥15	492	45.7	1	1
	<15	40	25.0	0.4 (0.19-0.83)*	0.44 (0.19-1.02) [¶]
	Never had sex	13	23.1	0.36 (0.10-1.31)	-
	Don't know	18	27.8	0.46 (0.16-1.30)	0.57 (0.17-1.88)
Number of sex partners in last year	None or one	450	41.6	1	
	Two	69	49.3	1.37 (0.82-2.27)	
	Three or more	33	54.5	1.69 (0.83-3.43)	
Lifetime number of sex partners	None or one	157	36.9	0.7 (0.45-1.08)	
	Two	99	43.4	0.92 (0.56-1.50)	
	Three or more	182	45.6	1	
	Don't know	122	47.5	1.08 (0.68-1.71)	
Frequency of condom use ^Ω	Never use	361	42.4	1	1
	Inconsistent	98	57.1	1.81 (1.15-2.85)*	1.78 (1.06-3.00)*
	Consistent	14	50.0	1.36 (0.47-3.96)	1.04 (0.29-3.68)
	Never had sex	13	23.1	0.41 (0.11-1.51)	0.39 (0.08-1.77)
	Don't know	78	30.8	0.6 (0.36-1.02)	0.55 (0.25-1.20)
Has a relative who is HIV positive	No	355	40.6	1	
	Yes	171	51.5	1.55 (1.08-2.24)*	
	Don't know	31	35.5	0.81 (0.37-1.73)	
Knows somebody taking ART	No	248	37.5	0.64 (0.45-0.90)*	
	Yes	276	48.6	1	
	Don't know	32	50.0	1.06 (0.51-2.20)	

[#]Characteristics and behavioural variables are those reported at Sero6, unless otherwise stated

*p≤0.05, [¶]p≤0.1, ^Δ Spouse HIV status and VCT use at Sero6,

^Ω Frequency of condom use in last 12 months considering three most recent partners

5.5 Discussion

The uptake of HTC services increased steadily in Kisesa between 2003 and 2010, with 9.4% of all participants using VCT at Sero4, 16.6% at Sero5 and 25.5% at Sero6. In spite of this, by the end of the Sero6 round (n=8,008), a substantial proportion of participants had never used any HTC service – approximately 36% of all HIV-positive individuals and 54% of all HIV-negative individuals. Furthermore, among participants who attended all three sero-survey rounds (n=2,010), almost half (48.0%) had never used any HTC service (at sero-survey and/or elsewhere). This figure rose to almost two-thirds (64.0%) if considering VCT use during sero-survey rounds only.

Considering the rapid expansion of HIV testing and treatment services within the study area over the time period in question, it is disappointing that the proportions of individuals who had used an HTC service at least once were not even larger. Previous research has identified numerous barriers to the uptake of HIV testing services in sub-Saharan Africa including prohibitive costs associated with travelling to health clinics, shortages of test-kit supplies, high levels of stigma and discrimination and concerns about confidentiality (19, 24, 65, 158-161). It is likely that stigma formed the greatest barrier to VCT use during sero-surveys in this study, as transport was provided free of charge, test-kits were adequately supplied, and previous research has found trust in sero-survey counsellors to be high (43). However, previous qualitative studies have found high levels of HIV-related stigma in Kisesa, which results in fear and a reluctance to test (16, 162). Outside of sero-surveys, it is likely that a combination of the factors mentioned above contributed to the low rates of uptake of testing seen.

At each sero-survey round, those who had previously used an HTC service were significantly more likely to use the VCT service offered than those who had never used HTC before. However, among participants who attended all three sero-survey rounds (n=2,010), the proportions repeat testing (i.e. using HTC twice or more) were low, with 11.1% using the VCT service offered at sero twice or more, and 25.3% having tested twice or more if reported use of HTC outside of sero-surveys was taken into account. As the latter estimate includes data on reported use of HTC services, we expect some error around it. However, the numbers of participants over

and under reporting previous VCT use were very similar, with 399/917 (43.5%) of all individuals over-reporting previous VCT use that *did not* occur, and 378/896 (42.2%) under-reporting previous VCT use that *did* occur. As a result, the estimate is likely to provide a fairly accurate measure of the proportion of individuals who repeat tested among those who attended all three sero-survey rounds. While repeat HTC use did increase over time, the proportions testing more than once were still low by the end of the Sero6 round, when 16.7% of all men and 22.9% of all women had ever repeat tested.

The proportions of participants repeat testing in Kisesa are somewhat lower than has been reported elsewhere in sub-Saharan Africa, where estimates ranged from 24.2% in a community cohort study in Uganda (83) to 73.4% in another cohort study in Malawi (84). HTC services were provided in the home in both of these studies, which may have contributed to the higher rates of uptake seen. One recent systematic review found that home-based HTC may be one way in which to substantially increase the numbers of people undergoing HIV testing in sub-Saharan Africa (70), although such a service would likely place significant financial and logistical demands on the local health service infrastructure. In Kisesa, it is clear that HIV testing rates are currently well below the one test per adult per year required by Granich *et al*/in their model (30), and further dramatic increases in the rate of uptake would be required if TasP were to be implemented.

In the analysis of factors associated with repeat VCT use (among those attending Seros 5 and 6), there was some evidence that HIV-negative people with higher risk sexual behaviours were among those who were most likely to repeat test. This is encouraging in terms of the potential to pick up those who are most at risk of HIV-infection. However, sero-converters were not significantly more likely to repeat test than those who did not sero-convert. Only 7 individuals sero-converted between the two rounds in this analysis, and so our sample size may have been too small to detect any meaningful difference. Other characteristics which were significantly associated with repeat VCT use included area of residence and level of education, highlighting a persistent inequity among those gaining access to HTC which was first seen in 2003-2004 (42).

Outside of sero-surveys, most participants reported having used HTC services at Kisesa health centre, where the VCT clinic was favoured disproportionately by women. This may reflect women who were offered PITC at the antenatal clinic but who were subsequently referred to the VCT clinic for testing (possibly due to shortages of staff or other resources at the antenatal clinic). However, it may also reflect a disinclination among men to use the health centre, which may be viewed as a place for women to receive services. Other HTC services such as mobile VCT clinics and the Angaza VCT clinic in Mwanza were used more equally by men and by women, but by smaller numbers of individuals overall, likely as a result of their temporary availability (mobile VCT clinics) or distance from the study area (Angaza clinic). With ever larger numbers of women being tested for HIV antenatally in sub-Saharan Africa (56), men may increasingly represent an under-served group in some settings.

This study has a number of strengths including a wealth of data covering an important period of time in terms of the development and increasing availability of HIV testing and treatment services in Kisesa. The study made use of data on both reported and actual use of HTC services, allowing for comparison of rates of testing using the two different data sources. It also allowed for comparison of the accuracy of reported versus actual HTC use, which was seen to be variable. This may have been caused by confusion when answering questions relating to previous HTC use and the exact location of any testing, and/or as a result of reporting biases.

We have seen declining participation rates in the Kisesa cohort study over time, particularly among younger men living in urban areas (Urassa *et al*, unpublished data), which may have affected our results. HIV-positive individuals may have been disproportionately represented among those not participating (163), which may have biased estimates of repeat testing upwards, as HIV-positive participants were seen to be less likely to repeat test in multivariable analyses. However, the main group of interest in terms of repeat testing is HIV-negative individuals. In contrast, estimates of repeat testing may have been biased downwards as a result of lesser participation among men living in urban areas, where people were significantly more likely to use HTC.

5.6 Conclusions

Although the proportion of individuals using HTC services increased in Kisesa over time, further increases in the rates of first time and repeat HTC use would be required if TasP were to be implemented. Programmes and interventions designed to address the persistence of HIV-related stigma and discrimination are urgently needed, as are interventions designed to increase the uptake of HTC among those living in rural areas and those with least education.

6 Paper C. The impact of voluntary counselling and testing services on sexual behaviour change and HIV incidence: observations from a cohort study in rural Tanzania

Introduction to the paper

Although there is great interest in increasing HTC uptake in sub-Saharan Africa due to greater availability of ART and as a means to achieve the potential of TasP approaches, one of the original premises of HTC service provision is that it can contribute to HIV-prevention by encouraging sexual risk reduction among both HIV-negative and HIV-positive individuals (4, 5). Paper C (published in BMC Infectious Diseases) moves on to explore this topic, investigating the impact of the CO-HTC service provided during sero-surveys² on changes in reported sexual behaviour and HIV incidence. Previous studies assessing the impact of HTC on sexual risk behaviour or HIV incidence have not investigated trends before and after greater availability of ART. In this paper, we explore the impact of HTC first between 2003-2004 and 2006-2007, when ART was available in Mwanza city 20 kilometres away (from the start of 2005) but not within the study area itself, and then between 2006-2007 and 2010, when ART was available at Kisesa Health Centre. Results for the analyses of the impact of HTC on sexual behaviour outcomes are stratified by HIV status, in order to detect possible differences between individuals testing HIV-negative and those testing HIV-positive.

² Referred to in the paper as the sero-survey VCT service

RESEARCH PAPER COVER SHEET

PLEASE NOTE THAT A COVER SHEET MUST BE COMPLETED FOR EACH RESEARCH PAPER INCLUDED IN A THESIS.

SECTION A – Student Details

Student	Caoimhe Cawley
Principal Supervisor	Alison Wringe
Thesis Title	Understanding the role of HIV testing and counselling services in HIV prevention in rural Tanzania

If the Research Paper has previously been published please complete Section B. if not please move to Section C

SECTION B – Paper already published

Where was the work published?	BMC Infectious Diseases		
When was the work published?	March 2014		
If the work was published prior to registration for your research degree, give a brief rationale for its inclusion	N/A		
Have you retained the copyright for the work?*	Yes	Was the work subject to academic peer review?	Yes

(see Appendix 11.4.2)

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For multi-authored work, give full details of your role in the research included in the paper and in the preparation of the paper. (Attach a further sheet if necessary)	I extracted, merged and cleaned the data, designed and conducted the data analyses and wrote the manuscript for this paper.
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Student Signature:

Date: 14/04/2015

Supervisor Signature:

Date: 14/04/2015

Published manuscript

6.1 Abstract

Background: It is widely assumed that voluntary counselling and testing (VCT) services contribute to HIV prevention by motivating clients to reduce sexual risk-taking. However, findings from sub-Saharan Africa have been mixed, particularly among HIV-negative persons. We explored associations between VCT use and changes in sexual risk behaviours and HIV incidence using data from a community HIV cohort study in northwest Tanzania.

Methods: Data on VCT use, sexual behaviour and HIV status were available from three HIV serological surveillance rounds undertaken in 2003–4 (Sero4), 2006–7 (Sero5) and 2010 (Sero6). We used multinomial logistic regression to assess changes in sexual risk behaviours between rounds, and Poisson regression to estimate HIV incidence.

Results: The analyses included 3,613 participants attending Sero4 and Sero5 (3,474 HIV-negative and 139 HIV-positive at earlier round) and 2,998 attending Sero5 and Sero6 (2,858 HIV-negative and 140 HIV-positive at earlier round). Among HIV-negative individuals VCT use was associated with reductions in the number of sexual partners in the last year (aRR Seros 4–5: 1.42, 95% CI 1.07-1.88; aRR Seros 5–6: 1.68, 95% CI 1.25-2.26) and in the likelihood of having a non-cohabiting partner in the last year (aRR Seros 4–5: 1.57, 95% CI 1.10-2.25; aRR Seros 5–6: 1.48, 95% CI 1.07-2.04) or a high-risk partner in the last year (aRR Seros 5–6 1.57, 95% CI 1.06-2.31). However, VCT was also associated with stopping using condoms with non-cohabiting partners between Seros 4–5 (aRR 4.88, 95% CI 1.39-17.16). There were no statistically significant associations between VCT use and changes in HIV incidence, nor changes in sexual behaviour among HIV-positive individuals, possibly due to small sample sizes.

Conclusions: We found moderate associations between VCT use and reductions in some sexual risk behaviours among HIV-negative participants, but no impacts among HIV-positive individuals in the context of low overall VCT uptake. Furthermore, there were no significant changes in HIV incidence associated with VCT use, although declining background incidence and small sample sizes may have prevented us from detecting this. The impact of VCT services will ultimately depend upon rates of uptake, with further research required to better understand processes of behaviour change following VCT use.

6.2 Background

Voluntary counselling and testing (VCT) for HIV has been promoted as a gateway for access to HIV treatment and care. Concurrently, the services' potential contribution to HIV prevention has been emphasized; it is hypothesized that knowledge of HIV sero-status, accompanied by tailored and targeted risk reduction counselling, will assist both HIV-negative and HIV-positive individuals to reduce sexual risk-taking and protect themselves and their partners from HIV (20, 154). Previous studies have found mixed results with regard to the impact of VCT on reductions in sexual risk behaviour. These have generally found greater impact among individuals testing HIV-positive compared to those testing negative (22, 23, 96). However, some studies have found no association between VCT use and changes in sexual behaviour (99, 102), while others have found increases in sexual risk taking among individuals testing HIV-negative (24). Few studies have assessed the impact of VCT on HIV incidence, however overall, these have found no significant differences between participants who received and did not receive VCT (23).

The measurement and comparison of indicators of sexual risk behaviour over time and between populations is difficult for a number of reasons, possibly explaining previous ambiguous findings regarding the impact of VCT on sexual behaviour change. Firstly, self-reported sexual behaviour data are often subject to recall and social desirability biases, the levels of which may vary depending on the behaviour in question, the amount of time that has passed since the event, and past exposure to HIV prevention messages (164). Secondly, developing measures or indicators of sexual risk behaviour which are specific enough to accurately capture information on an individual's sexual risk profile, yet general enough to be comparable across populations or over time, is difficult (165). Nevertheless, while measures of sexual behaviour have not always correlated well with rates of HIV incidence or prevalence (166-168), trends in these indicators have aided our understanding of the HIV epidemic and its relationship with sexual risk behaviour (169).

In this paper, we assess the impact of VCT use on changes in reported sexual risk behaviours and HIV incidence using data from consecutive rounds of HIV

serological surveillance (sero-surveys) which have been carried out as part of an on-going community cohort study in northwest Tanzania since 1994. VCT services were provided during three sero-surveys in 2003-4, 2006-7 and 2010.

6.3 Methods

6.3.1 Study setting

The study setting in Mwanza region has been described in detail by Mwaluko *et al* (142). Briefly, the study area lies approximately 20km to the east of Mwanza city and consists of six villages which make up the administrative ward of Kisesa, with a combined population of approximately 32,000 people, roughly half of whom are adults. The cohort consists of rounds of demographic surveillance taking place approximately once every six months since 1994, and rounds of HIV serological surveillance among adults aged 15 or older once every two to three years. HIV prevalence in the study area rose from 6.0% (95% CI 5.3% to 6.4%) in 1994-5 to 8.2% (95% CI 7.7% to 8.8%) in 2003-4 (170), before falling to 6.5% (95% CI 6.0% to 7.0%) in 2010 (R. Isingo, personal communication). This pattern may be explained by net in-migration of HIV infected individuals into the study area in the 1990's, and a falling HIV incidence in the study area since the late 1990s (140).

Sero-surveys take place at a central point in each village, with dry-blood spot samples taken for ascertainment of HIV-status using a protocol based on informed consent without disclosure. HIV diagnosis is based on two ELIZAs (Uniform 2, Enzygnost HIV1/HIV2). A detailed questionnaire is administered by same sex interviewers, covering topics on socio-demographic characteristics, sexual behaviour and participants' previous use of VCT services including the place and circumstances of testing, e.g. whether at a previous sero-survey or elsewhere (and if so, where).

Since the fourth sero-survey round in 2003-4 (Sero4), a separate VCT service following Tanzanian national guidelines and including pre- and post-test counselling (6) has been available to all study participants. Individuals wishing to know their HIV status are directed to a purpose-constructed hut for VCT with a trained counsellor directly after completing their questionnaire interview. At Sero4, venous blood was

collected and transported to the National Institute for Medical Research (NIMR) in Mwanza, with diagnosis based on two ELIZAs as for research tests, and clients asked to return for their test results and post-test counselling one week later. During the fifth and sixth sero-survey rounds in 2006-7 (Sero5) and 2010 (Sero6) venous blood was again collected but rapid HIV screening tests were used (preliminary test using Capillus, confirmatory test using Determine. Discrepant results resolved using two ELIZAs as for research tests). Quality control was performed at the NIMR laboratory on a 5% sub-sample using two ELIZAs. During Sero5 and Sero6, HIV results and post-test counselling were usually available within 45 minutes of the rapid test being performed. Data on the uptake of VCT at sero-surveys are anonymously linked to the main sero-survey questionnaire using unique, numerical participant identifiers.

Although free antiretroviral therapy (ART) was not available in 2003-4, individuals with an HIV-positive result after using VCT at Sero4 were informed that treatment would become available in the region in the near future through the national ART programme, which started at the beginning of 2005. With their prior agreement, these individuals were subsequently traced by the VCT counsellors and referred to the zonal referral hospital in Mwanza city for follow-up care. Individuals using VCT and testing HIV-positive at Sero5 were referred directly to Mwanza city hospitals. By Sero6 in 2010, a care and treatment centre (CTC) was available locally at the health centre in Kisesa and so HIV-positive patients were referred here.

6.3.2 Other health services in the study area

The study population is served by a government-run health centre located in Kisesa trading centre, by three small government-run dispensaries located in the rural villages, and by a number of private clinics located mainly in the trading centre. A stand-alone VCT clinic has been available at Kisesa health centre since 2005, while provider initiated testing and counselling (PITC) has been offered to all pregnant women attending the health centre for antenatal care since the end of 2008. PITC has also been available at the out-patients department since 2010, where testing may be offered to patients attending the sexually transmitted infections or tuberculosis clinics. Since mid-2009, antenatal PITC is sometimes offered to women attending the small rural dispensaries, dependant on the availability of test-kit supplies.

6.3.3 Ethical statement

Ethical approval for the Kisesa cohort study has been granted by the Tanzanian Medical Research Coordinating Committee and the Ethics Committee of the London School of Hygiene and Tropical Medicine. Participation is based on informed consent without disclosure of HIV-research test results, however since Sero4 (just prior to the introduction of ART), participants are additionally offered a free VCT service as detailed above. During Sero4 verbal consent was obtained, due to low literacy rates among the study population. This was witnessed and documented for each participant on their study questionnaire, by a member of the sero-survey team. During Sero5 and Sero6 written consent was introduced (either a signature or a thumb-print, depending on the participant's writing ability).

6.3.4 Data and analysis

Nine indices of sexual behaviour were used: the number of sex partners in the last year, the acquisition or loss of spouse, regular non-cohabiting sexual partner, or high risk sex partner in the last year, whether a condom was used with spouse, regular non-cohabiting sexual partner, or high risk partner at last sex, and the coital frequency with spouse or regular non-cohabiting sexual partner in the last week. Changes in sexual behaviour were determined by comparing behaviours reported at one round with those reported at the next, in order to determine whether there had been an increase, decrease or no change in behaviour. For quantitative variables (number of sexual partners, coital frequency), differences in the constructed behaviour change variables greater than zero indicated an increase in sexual risk behaviour while values less than zero indicated a decrease and a value of zero indicated no change. For changes in binary variables (condom use at last sex), the indices represented the direction of change in behaviour, with 1 representing increased risk, 0 no change and -1 decreased risk. Multinomial logistic regression was used to assess the association between VCT and each of the nine indices of sexual behaviour change. Crude associations were adjusted for socio-demographic variables (age, sex, marital status, area of residence, level of education and reported previous use of VCT) in multivariable analyses.

In order to explore any potential differences over time, analyses were carried out separately for those a) attending both Sero4 and Sero5 and using the VCT service at Sero4, b) attending both Sero5 and Sero6 and using the VCT service at Sero5. Analyses were restricted to the non-virgin population (those who reported having ever had sex) and considered separately for individuals testing HIV-negative and HIV-positive at the time of going for VCT.

HIV incidence was estimated based on the number of initially HIV-negative respondents who seroconverted between Seros 4 and 5, and Seros 5 and 6, respectively. Dates of sero-conversion were assigned based on the midpoint between sero-survey interview dates. Poisson regression models were used to calculate crude and adjusted HIV incidence rates comparing VCT users and non-users.

6.4 Results

6.4.1 Descriptive characteristics

In total 8,961 participants attended Sero4 (participation rate of 66% (170)), of whom 3,923 (43.8%) also attended Sero5. Of these, 3,613/3,923 (92.1%) reported that they had ever had sex. 933/3,613 (25.8%) individuals expressed a desire for VCT while 324/3,613 (9.0%) actually returned to receive their results and complete VCT. In total 8,696 participants attended Sero5 (participation rate of 61% (140)), of whom 3,509 also attended Sero6 (40.3%), with 2,998/3,509 (85.4%) reporting having ever had sex. Of these, 525/2,998 (17.5%) individuals expressed a desire for VCT while 532/2,998 (17.7%) actually completed VCT. The descriptive characteristics of the non-virgin population attending the two sets of sero-survey rounds are shown in Table 6.1. The largest proportions of attendees were female and fell in the ≥ 45 age-group. Of those attending Sero4 and Sero5, 139/3,613 participants (3.8%) were HIV-positive, while 23/324 (7.1%) of those who used VCT at Sero4 were HIV-positive. Of those attending Sero5 and Sero6, 140/2,998 (4.7%) were HIV-positive and 29/532 (5.4%) of those who used VCT at Sero5 were HIV-positive.

Across both sets of rounds, approximately 60% of attendees were married monogamously with a further 10% being in polygamous marriages. Most

participants reported having one sexual partner (in the last year), and not having any regular non-cohabiting or high risk partners (also in the last year - Table 6.1). Condom use was rare, with just 7.4% reporting ever using a condom at Sero4, and 9.2% reporting ever using a condom with the three most recent sexual partners at Sero5.

Table 6.1 Characteristics (at earlier round) of individuals attending i) Sero4 and Sero5, ii) Sero5 and Sero6, by VCT use at earlier round

		Attended Sero4 and Sero5			Attended Sero5 and Sero6		
		No VCT N (%)	Had VCT N (%)	Total	No VCT N (%)	Had VCT N (%)	Total
Total		3289 (91.0)	324 (9.0)	3613 (100)	2466 (82.3)	532 (17.7)	2998 (100)
Sex	Male	1228 (87.1)	182 (12.9)	1420 (100)	795 (78.5)	218 (21.5)	1013 (100)
	Female	2061 (93.6)	142 (6.4)	2203 (100)	1671 (84.2)	314 (15.8)	1985 (100)
Age	15-24	815 (92.1)	70 (7.9)	885 (100)	480 (80.8)	114 (19.2)	594 (100)
	25-34	731 (86.7)	112 (13.3)	843 (100)	549 (78.1)	154 (21.9)	703 (100)
	35-44	673 (89.4)	80 (10.6)	753 (100)	471 (77.2)	139 (22.8)	610 (100)
	>=45	1070 (94.5)	62 (5.5)	1132 (100)	966 (88.5)	125 (11.5)	1091 (100)
HIV status	Negative	3173 (91.3)	301 (8.7)	3474 (100)	2355 (82.4)	503 (17.6)	2858 (100)
	Positive	116 (83.5)	23 (16.5)	139 (100)	111 (79.3)	29 (20.7)	140 (100)
Reported previous use of VCT ^{\$*}	No	3046 (92.2)	258 (7.8)	3304 (100)	1667 (88.9)	208 (11.1)	1875 (100)
	Yes	243 (78.6)	66 (21.4)	309 (100)	728 (69.7)	317 (30.3)	1045 (100)
Number of sexual partners in last year	None	392 (97.5)	10 (2.5)	402 (100)	490 (92.3)	41 (7.7)	531 (100)
	One	2195 (91.8)	195 (8.2)	2390 (100)	1755 (81.8)	390 (18.2)	2145 (100)
	Two or more	702 (85.5)	119 (14.5)	821 (100)	221 (68.6)	101 (31.4)	322 (100)
Marital status ^{\$β}	Never married	435 (88.8)	55 (11.2)	490 (100)	294 (81.4)	67 (18.6)	361 (100)
	Marr monogamous	1946 (90.9)	195 (9.1)	2141 (100)	1392 (80.7)	332 (19.3)	1724 (100)
	Marr polygamous	303 (91.0)	30 (9.0)	333 (100)	268 (81.2)	62 (18.8)	330 (100)
	Widowed				276 (92.9)	21 (7.1)	297 (100)
	Separated/divorced				236 (82.5)	50 (17.5)	286 (100)
Regular non-cohabiting partner in last year ^{\$}	No	2776 (92.0)	242 (8.0)	3018 (100)	2130 (83.7)	415 (16.3)	2545 (100)
	Yes	513 (86.2)	82 (13.8)	595 (100)	331 (74.2)	115 (25.8)	446 (100)
High risk partner in last year ^{\$}	No	3185 (91.3)	302 (8.7)	3487 (100)	2297 (83.0)	471 (17.0)	2768 (100)
	Yes	104 (82.5)	22 (17.5)	126 (100)	157 (73.7)	56 (26.3)	213 (100)
Ever used a condom ^{\$#}	No	2907 (92.6)	231 (7.4)	3138 (100)	1778 (81.9)	393 (18.1)	2171 (100)
	Yes	380 (80.3)	93 (19.7)	473 (100)	133 (64.3)	74 (35.7)	207 (100)

^{\$}Small numbers of missing data (<3%)

^{*}Previous VCT use as reported at the later round (to account for any VCT use in the inter sero-survey period)

^β Data on widowed/separated not broken down at Sero4

[#] At Sero5 this variable related to ever use of condoms with spouse or regular non-cohabiting partners only (N=2,403)

6.4.2 Impact of VCT on sexual behaviour change among HIV-negative individuals

Among HIV-negative individuals, VCT use was associated with some changes in sexual behaviour in terms of the number and type of partnerships formed, but less so in terms of condom use or coital frequency (see Table 6.2 and Table 6.3). Between Sero4 and Sero5, compared to those who did not have VCT, VCT users had an increased likelihood of reducing their number of sexual partners in the last year (Table 6.2: adjusted risk ratio [aRR] 1.42, 95% confidence interval [CI] 1.07-1.88). A similar pattern was seen in terms of reduction in the number of sexual partners between Sero5 and Sero6 (Table 6.3: aRR 1.68, 95% CI 1.25-2.26).

Among HIV negative individuals, there was evidence that VCT use at Sero4 was associated with both acquiring (aRR 1.88, 95% CI 1.29-2.74) and losing (aRR 1.56, 95% CI 0.95-2.55) a spouse by Sero5 (Table 6.2). While similar trends were seen between Sero5 and Sero6, the results were not statistically significant (Table 6.3: aRR for acquiring a spouse: 1.19, 95% CI 0.82-1.73; aRR for losing a spouse: 1.12, 95% CI 0.74-1.70). Between Seros 4 and 5 and also between Seros 5 and 6, VCT use at the earlier round was also significantly associated with losing a regular non-cohabiting partner by the later round (aRR Seros 4-5: 1.57, 95% CI 1.10-2.25, aRR Seros 5-6: 1.48, 95% CI 1.07-2.04). Further investigation revealed that approximately half of those who acquired a spouse by the later round were the same people who had lost a regular non-cohabiting partner (144/298 or 48.3% of those acquiring a spouse between Sero4 and Sero5, and 106/202 or 52.5% of those acquiring a spouse between Sero5 and Sero6). As a result, at least some of the spousal acquisition between rounds is likely as a result of people marrying their regular partners. Between Seros 5 and 6, VCT use was also associated with losing a high-risk or casual partner (aRR 1.57, 95% CI 1.06-2.31).

In general there was no significant impact of VCT on condom use behaviour, although VCT at Sero4 was associated with an increased likelihood of stopping using condoms with regular non-cohabiting partners by Sero5 (aRR 4.88, 95% CI 1.39-17.16). Coital frequency information was not available at Sero4, but between Sero5 and Sero6, there was no evidence for an impact of VCT on changes in coital frequency with spouses or regular non-cohabiting partners in the last week (Table

6.3). In addition, there was no evidence to suggest any interaction between VCT use and gender in terms of any of the sexual behaviour change outcomes.

In total 2,010 participants attended all three sero-surveys, of whom 1,876 (93.3%) reported having ever had sex. Among these, 82/1,876 (4.4%) used VCT twice (at both Sero4 and Sero5) and 1,828/1,876 (97.4%) were HIV-negative at Sero4. In crude analyses among HIV negative individuals, those using VCT twice (at Sero4 and Sero5) were more likely to report increasing their number of sexual partners (RR 2.10, 95% CI 1.06-4.14) and acquiring a high-risk partner (RR 2.13, 95% CI 1.03-4.38) between Sero4 and Sero6, compared to those who did not use VCT twice. However there were no significant impacts of VCT on any of the sexual behaviour change outcomes in adjusted analyses.

Table 6.2 Change in sexual behaviour between Sero4 and Sero5 associated with VCT use at Sero4, HIV-negative individuals

N with outcome (%)					Crude Risk Ratio (95% CI)	Adjusted Risk Ratio (95% CI) [¶]
No VCT		Had VCT				
Number of sex partners in last year						
	3173	%	301	%		
No change	2060	64.9	169	56.1	1	
Increase	306	9.6	25	8.3	1 (0.64-1.54)	0.82 (0.52-1.30)
Decrease	807	25.4	107	35.5	1.62 (1.25-2.09)***	1.42 (1.07-1.88)**
Acquired or lost a spouse ^α						
	3136	%	297	%		
No change	2701	86.1	233	78.5	1	1
Acquired	255	8.1	43	14.5	1.95 (1.38-2.77)***	1.88 (1.29-2.74)***
Lost	180	5.7	21	7.1	1.35 (0.84-2.17)	1.56 (0.95-2.55)*
Acquired or lost a regular non-cohabiting partner						
	3168	%	301	%		
No change	2601	82.1	226	75.1	1	1
Acquired	251	7.9	27	9.0	1.24 (0.81-1.88)	0.88 (0.55-1.43)
Lost	316	10.0	48	15.9	1.75 (1.25-2.44)***	1.57 (1.10-2.25)**
Acquired or lost a high risk partner						
	3156	%	299	%		
No change	2879	91.2	267	89.3	1	1
Acquired	193	6.1	19	6.4	1.06 (0.65-1.73)	0.97 (0.58-1.62)
Lost	84	2.7	13	4.3	1.67 (0.92-3.03)	1.41 (0.75-2.65)
Condom use at last sex with spouse [#]						
	2000	%	190	%		
No change	1951	97.6	184	96.8	1	1
Stopped using	31	1.6	2	1.1	0.68 (0.16-2.88)	0.45 (0.10-1.93)
Started using	18	0.9	4	2.1	2.36 (0.79-7.04)	1.79 (0.56-5.67)
Condom use at last sex with regular non-cohabiting partner [#]						
	179	%	31	%		
No change	147	82.1	17	54.8	1	1
Stopped using	12	6.7	8	25.8	5.76 (2.07-16.08)***	4.88 (1.39-17.16)**
Started using	20	11.2	6	19.4	2.59 (0.92-7.35)	2.21 (0.60-8.14)
Condom use at last sex with high risk partner [#]						
	12	%	5	%		
No change	8	66.7	3	60.0	1	-
Stopped using	1	8.3	1	20.0	2.67 (0.12-57.62)	-
Started using	3	25.0	1	20.0	0.89 (0.06-12.25)	-

¶ All outcomes adjusted for age, sex, marital status, area of residence, level of education and previous VCT use as reported at the later sero-survey round

*p≤0.1, **p≤0.05, ***p≤0.001

α 'Acquired or lost spouse' was not adjusted for marital status (as this was the outcome)

Analyses conducted among those with relevant partner type at both rounds only

Table 6.3 Change in sexual behaviour between Sero5 and Sero6 associated with VCT use at Sero5, HIV-negative individuals

N with outcome (%)					Crude Risk Ratio (95% CI)	Adjusted Risk Ratio (95% CI) [¶]
No VCT		Had VCT				
Number of sex partners in last year						
	2336	%	502	%		
No change	1732	74.1	338	67.3	1	1
Increase	272	11.6	74	14.7	1.39 (1.05,1.85)**	1.13 (0.82,1.55)
Decrease	332	14.2	90	17.9	1.39 (1.07,1.80)**	1.68 (1.25,2.26)***
Acquired or lost a spouse ^α						
	2346	%	500	%		
No change	2043	87.1	423	84.6	1	1
Acquired	158	6.7	44	8.8	1.35 (0.95,1.91)*	1.19 (0.82,1.73)
Lost	145	6.2	33	6.6	1.1 (0.74,1.63)	1.12 (0.74,1.70)
Acquired or lost a regular non-cohabiting partner						
	2350	%	501	%		
No change	2017	85.8	399	79.6	1	1
Acquired	90	3.8	23	4.6	1.29 (0.81,2.07)	1.23 (0.73,2.07)
Lost	243	10.3	79	15.8	1.64 (1.25,2.16)***	1.48 (1.07,2.04)**
Acquired or lost a high risk or casual partner ^Ω						
	2344	%	498	%		
No change	2062	88.0	406	81.5	1	1
Acquired	153	6.5	48	9.6	1.59 (1.13,2.24)**	1.28 (0.84,1.95)
Lost	129	5.5	44	8.8	1.73 (1.21,2.48)**	1.57 (1.06,2.31)**
Condom use at last sex with spouse [#]						
	1379	%	332	%		
No change	1345	97.5	326	98.2	1	1
Stopped using	18	1.3	3	0.9	0.69 (0.20,2.35)	0.64 (0.18,2.28)
Started using	16	1.2	3	0.9	0.77 (0.22,2.67)	0.62 (0.17,2.29)
Condom use at last sex with regular non-cohabiting partner [#]						
	75	%	29	%		
No change	51	68.0	20	69.0	1	1
Stopped using	12	16.0	5	17.2	1.06 (0.33,3.40)	0.70 (0.14,3.54)
Started using	12	16.0	4	13.8	0.85 (0.24,2.95)	0.32 (0.06,1.63)
Condom use at last sex with high risk or casual partner ^{#Ω}						
	18	%	10	%		
No change	10	55.6	6	60.0	1	1
Stopped using	1	5.6	2	20.0	3.33 (0.25,45.11)	-
Started using	7	38.9	2	20.0	0.48 (0.07,3.09)	-
Number of times sex with spouse in last week [#]						
	1388	%	335	%		
No change	384	27.7	81	24.2	1	1
Increase	296	21.3	68	20.3	1.09 (0.76,1.56)	1.03 (0.71,1.51)
Decrease	708	51.0	186	55.5	1.25 (0.93,1.66)	1.3 (0.96,1.77)
Number of times sex with regular non-cohabiting partner in last week [#]						
	75	%	29	%		
No change	27	36.0	11	37.9	1	1
Increase	19	25.3	7	24.1	0.9 (0.30,2.76)	0.83 (0.21,3.32)
Decrease	29	38.7	11	37.9	0.93 (0.35,2.50)	0.92 (0.27,3.14)

¶ All outcomes adjusted for age, sex, marital status, area of residence, level of education and previous VCT use as reported at the later sero-survey round

*p≤0.1, **p≤0.05, ***p≤0.001

α Acquired or lost spouse' was not adjusted for marital status (as this was the outcome)

Ω Questions related to 'casual' rather than 'high risk' partners at Sero6, however, the two categories were considered comparable

Analyses conducted among those with relevant partner type at both rounds only

6.4.3 Impact of VCT on HIV incidence

Between Sero4 and Sero5, HIV incidence among those who did not use VCT at Sero4 was 0.86 per 100 person years (95% CI 0.70-1.06), while it was 1.04 per 100 person years (95% CI 0.56-1.94) among those who used VCT. The corresponding incidence between Sero5 and Sero6 was 0.66 per 100 person years (95% CI 0.46-0.93) among those who did not use VCT at Sero5 and 0.48 per 100 person years (95% CI 0.20-1.16) among those used VCT. In crude and adjusted analyses, VCT was not significantly associated with changes in HIV-incidence between either set of sero-survey rounds (Table 6.4).

Table 6.4 HIV incidence among initially HIV-negative participants, by VCT use at the earlier sero-survey round

	N	Person years	Seroconversions	Incidence per 100PY	Crude Rate Ratio (95% CI)	Adjusted Rate Ratio (95% CI)*
Attended Sero4 and Sero5						
No VCT	3160	10133.8	87	0.86 (0.70-1.06)	1	1
VCT	299	959.1	10	1.04 (0.56-1.94)	1.21 (0.63-2.34)	1.13 (0.58-2.22)
Attended Sero5 and Sero6						
No VCT	2343	4880.1	32	0.66 (0.46-0.93)	1	1
VCT	501	1031.0	5	0.48 (0.20-1.16)	0.74 (0.29-1.90)	0.69 (0.26-1.82)

*Adjusted for age, sex and previous VCT use as at reported at the later sero-survey round

6.4.4 Impact of VCT on sexual behaviour change among HIV-positive individuals

Fewer indicators of sexual behaviour change could be assessed among HIV-positive individuals due to small sample sizes, and VCT use was not significantly associated with changes in any of these in crude or adjusted analyses (Table 6.5 and Table 6.6).

However, for some indicators, the measures of effect seemed to go in opposite directions between Seros 4 and 5 and Seros 5 and 6. For example, a larger proportion of HIV-positive individuals using VCT at Sero4 lost a spouse by Sero5 (13.0% versus 11.4%, aRR 2.65, 95% CI 0.46-15.23) and acquired a regular non-cohabiting partner by Sero5 (30.4% versus 17.5%, aRR 3.46, 95% CI 0.71-16.83) compared to those not using VCT. The opposite effect was seen between Seros 5 and 6. Compared to those not using VCT, HIV-positive individuals using VCT at

Sero5 were more likely to acquire a spouse (10.3% versus 2.7%, aRR 4.35, 95% CI 0.68-27.93) and to lose a non-cohabiting partner (20.7% versus 11.7%, aRR 1.59, 95% CI 0.45-5.64) by Sero6. However, the confidence intervals around all of these estimates are very wide.

In crude analyses, VCT use at both Sero4 and Sero5 seemed to be associated with an increased likelihood of both stopping and starting using condoms at last sex with spouse by the next round (Table 6.5 and Table 6.6). However, the numbers contributing to these analyses were very small (six participants between Seros 4 and 5, eight participants between Seros 5 and 6). As a result, the results were not statistically significant, nor was it possible to adjust for or investigate the effect of possible confounders.

Pooling the data for both sets of rounds (taking account of clustering for those who attended all three rounds) did reveal some evidence for an association between VCT use and a reduction in some sexual risk behaviours between rounds (results not shown). In these analyses, HIV-positive individuals using VCT at the earlier round seemed less likely to increase their number of sexual partners in the last year by the next round as compared to those not using VCT (aRR 0.22, 95% CI 0.05-1.01, $p=0.05$).

Table 6.5 Change in sexual behaviour between Sero4 and Sero5 associated with VCT use at Sero4, HIV-positive individuals

With VCT use at Serot, HIV positive individuals						
	N with outcome (%)				Crude Risk Ratio (95% CI)	Adjusted Risk Ratio (95% CI) [†]
	No VCT		Had VCT			
Number of sex partners in last year						
	115	%	23	%		
No change	64	55.7	13	56.5	1	1
Increase	16	13.9	0	0.0	-	-
Decrease	35	30.4	10	43.5	1.41 (0.56,3.54)	0.88 (0.25,3.02)
Acquired or lost a spouse^a						
	114	%	23	%		
No change	93	81.6	19	82.6	1	1
Acquired	8	7.0	1	4.3	0.61 (0.07,5.18)	0.64 (0.06,7.13)
Lost	13	11.4	3	13.0	1.13 (0.29,4.35)	2.65 (0.46,15.23)
Acquired or lost a regular non-cohabiting partner						
	114	%	23	%		
No change	79	69.3	15	65.2	1	1
Acquired	20	17.5	7	30.4	1.84 (0.66,5.12)	3.46 (0.71,16.83)
Lost	15	13.2	1	4.3	0.35 (0.04,2.86)	0.26 (0.02,2.85)
Acquired or lost a high risk partner						
	115	%	22	%		
No change	98	85.2	17	77.3	1	1
Acquired	10	8.7	1	4.5	0.58 (0.07,4.80)	0.63 (0.05,8.02)
Lost	7	6.1	4	18.2	3.29 (0.87,12.48)	3.10 (0.50,19.31)
Condom use at last sex with spouse[#]						
	68	%	12	%		
No change	64	94.1	10	83.3	1	1
Stopped using	2	2.9	1	8.3	3.2 (0.26,38.64)	0.99 (0.03,34.27)
Started using	2	2.9	1	8.3	3.2 (0.26,38.64)	-

¶ All outcomes adjusted for age, sex, marital status, area of residence, level of education and previous VCT use as reported at the later sero-survey round

α Acquired or lost spouse¹ was not adjusted for marital status (as this was the outcome)

Analyses conducted among those with a spouse at both rounds only

Table 6.6 Change in sexual behaviour between Sero5 and Sero6 associated with VCT use at the Sero5, HIV-positive individuals

N with outcome (%)						Crude Risk Ratio (95% CI)	Adjusted Risk Ratio (95% CI) [†]
No VCT		Had VCT					
Number of sex partners in last year							
	110	%	29	%			
No change	72	65.5	21	72.4	1		1
Increase	14	12.7	3	10.3	0.73 (0.19,2.80)		0.41 (0.08,2.12)
Decrease	24	21.8	5	17.2	0.71 (0.24,2.10)		0.56 (0.13,2.38)
Acquired or lost a spouse ^α							
	111	%	29	%			
No change	88	79.3	23	79.3	1		1
Acquired	3	2.7	3	10.3	3.83 (0.72,20.22)		4.35 (0.68,27.93)
Lost	20	18.0	3	10.3	0.57 (0.16,2.10)		0.68 (0.17,2.63)
Acquired or lost a regular non-cohabiting partner							
	111	%	29	%			
No change	90	81.1	22	75.9	1		1
Acquired	8	7.2	1	3.4	0.51 (0.06,4.31)		0.21 (0.01,3.25)
Lost	13	11.7	6	20.7	1.89 (0.65,5.53)		1.59 (0.45,5.63)
Acquired or lost a high risk or casual partner ^Ω							
	110	%	29	%			
No change	90	81.8	25	86.2	1		1
Acquired	11	10.0	3	10.3	0.98 (0.25,3.79)		0.53 (0.10,2.98)
Lost	9	8.2	1	3.4	0.4 (0.05,3.31)		0.32 (0.02,4.35)
Condom use at last sex with spouse [#]							
	61	%	18	%			
No change	56	91.8	15	83.3	1		1
Stopped using	2	3.3	1	5.6	1.87 (0.16,22.01)		-
Started using	3	4.9	2	11.1	2.49 (0.38,16.27)		-
Number of times sex with spouse in last week [#]							
	62	%	19	%			
No change	18	29.0	2	10.5	1		1
Increase	14	22.6	3	15.8	1.93 (0.28,13.16)		3.37 (0.26,44.11)
Decrease	30	48.4	14	73.7	4.2 (0.85,20.65)		7.55 (0.84,67.63)

¶ All outcomes adjusted for age, sex, marital status, area of residence, level of education and previous VCT use as reported at the later sero-survey round

α Acquired or lost spouse' was not adjusted for marital status (as this was the outcome)

Ω Questions related to 'casual' rather than 'high risk' partners at Sero6, however, the two categories were considered comparable

Analyses conducted among those with a spouse at both rounds only

6.5 Discussion

In this study, the overall uptake of VCT at the first two sero-surveys during which it was offered was low (10% and 17% at Seros 4 and 5 respectively (43)). A recent estimate of ART coverage among those in need in Kisesa (based on individuals HIV-positive at Sero5) was also low (just 2% - (171)). As in previous studies, our findings with regard to the impact of VCT on sexual behaviour change were mixed, with service use associated with changes in some behaviours but not others. However, it was encouraging that reductions in the numbers and types of partnerships formed persisted across both sets of sero-survey rounds.

We found no evidence for an impact of VCT on changes in HIV incidence. While it is possible that a declining incidence in the study area overall and a small number of sero-conversions may have prevented us from detecting this, a number of other studies have similarly found no impact of VCT on changes in HIV incidence (99, 172).

It was perhaps unsurprising that HIV-negative individuals were more likely to acquire a spouse after going for VCT, as young couples in sub-Saharan African are frequently advised to go for VCT before marriage. The interpretation or significance of the acquisition or loss of a spouse is somewhat different to the acquisition or loss of a high-risk partner. While acquisition of the latter may clearly be interpreted as a transition to higher risk behaviour, the acquisition of a spouse may be viewed as a shift to lower-risk behaviour as people theoretically move from a 'sexually active but single' state to a more stable, settled relationship. Conversely, the loss of a spouse (which might not be volitional, for example if it occurred as a result of widowhood) could be viewed as a transition to higher-risk behaviour as people leave settled relationships and return to a phase during which they may seek out new sexual partners.

It was somewhat more surprising that HIV-negative individuals using VCT at Sero4 were more likely to *lose* a spouse by Sero5 than those not using VCT. However, of the 201 HIV-negative individuals who lost a spouse between Sero4 and Sero5, 75 of these cases (37.3%) were as a result of widowhood. The observed association

between VCT use and spousal loss between Seros 4-5 may be linked to widowhood through reverse causality, as individuals with sick partners may have been more likely to go and test than individuals with healthy partners. Further qualitative research may help to elucidate the reasons why people go (or don't go) for VCT, the types of information that clients receive and the perceived importance of this information in helping people to change their sexual behaviour.

Condom use among study participants was low overall and VCT use was generally associated with little change in this behaviour. The finding that VCT use at Sero4 was associated with an increased likelihood of stopping using condoms at last sex with regular non-cohabiting partners by Sero5 is difficult to interpret, but may relate to the specific risk-profile of these non-cohabiting partners and/or whether they had also been for VCT and tested HIV-negative. A number of studies have found VCT use to be associated with increases in condom use (22, 92, 96) and so it was disappointing that we did not find similar results in this study. Condom use has previously been reported to be low in this part of Tanzania (173, 174), and it is possible that negative attitudes towards their use persist in spite of messages shared during VCT. Low levels of condom use could also relate to anecdotal evidence of problems relating to their availability or supply.

There were no statistically significant changes in sexual behaviour associated with VCT use among HIV-positive individuals, except for a reduced likelihood of increasing the number of sexual partners in the last year in the pooled analysis. In the analyses done separately by rounds, for some indicators the measures of effect seemed to go in opposite directions between the two sets of rounds. For example, between Seros 4-5, individuals using VCT and testing HIV-positive seemed more likely to lose a spouse but to acquire a regular non-cohabiting partner by Sero5 compared to those not using VCT. Conversely between Seros 5-6, those testing HIV-positive seemed more likely to acquire a spouse but to lose a regular partner by Sero6. These results may have arisen simply as a result of the small sample sizes which yielded non-statistically significant results, but other factors could also have been at play. For example, antiretroviral therapy was more widely available in the study area between Sero5 and Sero6, and this may have assisted participants in regaining health and acquiring more permanent spousal partners. Sero-sorting could also have been taking place, with more people aware of their HIV-status by the later

sero-survey rounds, allowing them to seek out other HIV-positive individuals with whom to form more permanent partnerships.

The limitations of this study relate to the observational nature of the data and to the pitfalls of working with self-reported sexual behaviour data, which are subject to recall and social desirability biases. We have previously shown that in Kisesa, VCT tends to attract individuals with higher risk sexual behaviours (43), and so as VCT uptake increases, the associations between VCT use and reductions in sexual risk behaviour among the general population may be weaker. In addition, we may have overstated the impacts of VCT if those who used the service were more likely to report declines in their risk behaviour compared to those who didn't. However, the community in Kisesa has been exposed to various HIV information and education campaigns over a number of years, and so all study participants are likely to have had some degree of exposure to HIV prevention messages.

Our ability to detect changes in levels of risk behaviour was limited by lack of knowledge of the sexual risk profile and HIV-status of partners. Take for example an individual who reported one sexual partner at both rounds, but who had an HIV-negative partner at the earlier round and an HIV-positive one at the later round. In this scenario, there would have been an increase in the level of risk between rounds which our behaviour change index would have been incapable of detecting. Further analyses among the subset of married and co-habiting couples for whom partner HIV-status are available may warrant investigation.

The strengths of this study relate to the fact that our VCT use data were documented rather than self-reported, and we were able to adjust for reported use of HIV counselling and testing services outside of sero-surveys, which should have helped to reduce levels of measurement error and residual confounding.

6.6 Conclusions

We found moderate but encouraging associations between VCT use and reductions in some sexual risk behaviours among HIV-negative participants, including reductions in the number of sexual partners in the last year, and a move to safer types of partnership. However, the overall uptake of VCT was low and we found no impacts of VCT on changes in HIV incidence. There were also no significant or consistent impacts of VCT on changes in sexual behaviour among HIV-positive individuals, but small sample sizes may have prevented us from discovering these. The impact of VCT services on sexual behaviour change and HIV prevention will ultimately depend upon rates of uptake, with further research required to better understand processes of behaviour change following VCT use.

7 Qualitative research methods

This chapter describes the overall aims of the qualitative research and the methods used, including the design and development of data collection tools, training of fieldworkers, sampling strategy and recruitment, and collection and analysis of data.

7.1 Aims and overview

The overall aims of the qualitative research were to explore perceptions of HTC services, and to understand how HIV prevention counselling messages might influence attitudes and intentions regarding sexual risk reduction. These data were expected to complement quantitative findings from the analyses presented in Chapter 6, by shedding light on factors influencing sexual behaviour change following HTC use. A period of qualitative fieldwork was undertaken in Kisesa between January and April 2012, using a variety of data collection tools in order to maximise learning from different methodologies and perspectives. Participatory learning and action (PLA) activities were conducted with community members including those who had and had not used HTC services, while in-depth interviews (IDIs) were carried out with HIV-negative and HIV-positive clients completing HTC. IDIs were also conducted with healthcare workers offering HTC, in order to explore provider perspectives.

7.2 Design and development of data collection tools

7.2.1 PLA activities

The objectives of the PLA activities were to 1) elicit general community perceptions and views about HTC services (regardless of the HIV or HTC use status of participants), 2) raise awareness and encourage support for HTC, 3) recruit HIV-negative and HIV-positive users of HTC services for IDIs (the recruitment procedures for IDIs are explained in Section 7.5.2 below). PLA activities were used as they can help to encourage processes of dialogue and change amongst study participants, by encouraging them to share knowledge with one another and to analyse situations or problems together (175, 176). Such activities can also help to encourage an exchange of information between researchers and study participants, which can in turn mobilise participants' support around the subject under

investigation (175, 176). The original guideline that was developed for the study contained two PLA activities. The first of these consisted of a brainstorming activity using flip-chart paper to allow participants to visually express ideas and opinions relating to HTC services, and to stimulate discussion between group members. The second activity involved sketching out steps along the pathway to eventual HTC use by an imagined typical community member, followed by a discussion of potential barriers at each step or stage along the pathway, as well as possible ways to avoid or reduce the magnitude of each barrier. Following piloting however (see Section 7.4 below), only the first brainstorming PLA activity was included in the discussion guide, in order to reduce the length and complexity of the group activities.

During the brainstorming activity, participants were divided into groups and encouraged to draw symbols or pictures on pieces of flipchart paper which represented their views or perceptions of HTC services. Themes explored included the perceived usefulness of HTC services, positive and negative aspects of service provision, and opinions relating to counsellors (see activity guideline in Appendix 11.2.6). All participants were then encouraged to discuss the ideas identified by each of the different groups, including whether they agreed or disagreed with the ideas expressed, whether the information provided was accurate, and whether they had any further information to add. At the end of the activity, facilitators addressed each of the topics explored in turn, elaborating on any additional information and sensitively correcting any misconceptions regarding availability or protocols for HTC service provision in Kisesa.

7.2.2 In-depth interviews

The aim of the IDIs with clients who had accessed HTC was to allow a detailed and confidential discussion of individual experiences of using services, with a view to understanding how HTC might influence changes in sexual risk behaviour. The discussion guide incorporated topics on motivations for going for HTC, location of testing, the relationship between client and counsellor during sessions, information and advice shared with and received from counsellors, attitudes and feelings regarding the counselling advice received and regarding sexual risk reduction, and experiences of disclosing HTC use to partners or other family members (see discussion guide in Appendix 11.2.7).

The IDIs with healthcare workers aimed to understand provider perspectives including counsellors' experiences of providing HTC and whether they felt services met clients' needs and/or helped to influence or encourage sexual behaviour change. The discussion guides varied depending on the role of the counsellor in question (whether s/he provided VCT or antenatal PITC), however in general they covered topics relating to length of time and experience providing HTC, the content and information shared during pre and post-test counselling sessions, community perceptions of HTC, and levels of training and support received. One IDI was conducted with an individual providing training for counsellors in order to understand the content of training programmes and ongoing professional development, support and supervision for counsellors. (See healthcare worker discussion guides in Appendices 11.2.8, 11.2.9 and 11.2.10).

All of the study tools were reviewed by social scientists with prior experience of conducting qualitative research in Kisesa, and were piloted prior to the start of data collection (see Section 7.4 below).

7.3 Recruitment and training of fieldworkers

Four Tanzanian fieldworkers (two men and two women) were recruited to assist with data collection activities, including one lead research assistant. All research assistants had some experience of qualitative data collection in Kisesa or elsewhere in Tanzania, including conducting focus group discussions and IDIs, however they had less experience facilitating PLAs. In preparation for the study, I designed and delivered a one-week training programme in collaboration with a senior social scientist based at NIMR Mwanza (Joyce Wamoyi). I prepared all of the training materials (background literature and information sheets, PowerPoint slides), and delivered most of the training sessions with the exception of the sessions on facilitating PLAs and the refresher session on IDIs, which were delivered in conjunction with Joyce Wamoyi.

The training activities introduced research assistants to the aims and objectives of the study, provided relevant background literature, covered ethical aspects relating

to confidentiality and informed consent, covered the theory and practical aspects relating to the use and facilitation of PLA activities, and offered a refresher session on facilitating IDIs. Time was devoted to familiarisation with the drafted PLA activities and IDI guidelines. Research assistants translated the data collection tools from English into Swahili in pairs. The study documents were then exchanged between pairs in order to verify translations and make sure the language used was appropriate. The training week also enabled a discussion of best practices for planning the study schedule and recruitment procedures, based on previous experience in Kisesa.

7.4 Piloting

The training week included an opportunity for research assistants to facilitate the planned PLA activities using the rest of the research team as proxy participants. Based on this exercise and on feedback from the research assistants as well as the senior social scientist, amendments to the activity guide were made including reducing the number of PLA activities from two to one. This was primarily because the second PLA activity appeared prohibitively complex to implement within a single two to three hour session, as had been allocated for each group activity.

Research assistants were also given the opportunity to pilot the HTC-user IDI guide with volunteer participants (other colleagues working on unrelated projects at NIMR Mwanza) in Swahili. I held de-briefing sessions with the research assistants during which they highlighted any challenges or issues they encountered while piloting the IDIs, and refinements to the wording of the topic guide were made accordingly.

7.5 Sampling strategy and recruitment

7.5.1 PLA activities

A combination of purposive sampling and snowball techniques were used to recruit participants for the group activities. First, individuals were purposively selected from a sampling frame which was constructed from the demographic, sero-surveillance and linked HTC clinic-cohort datasets. This allowed inclusion of individuals who were known or reported to have used HTC services during sero-surveys or at Kisesa Health Centre, as well some individuals who had not used HTC. This

'seeded' focus group approach (177) allowed us to include HTC clients in the group activities without inadvertently revealing their HTC-use status to other study participants. Some 'seeded' HTC users were HIV-positive, however field workers were unaware of the HIV status of any participants. Next, each purposively sampled individual who agreed to participate was asked to invite a neighbour or friend from their village and from the same age group to take part in the activity.

I prepared the recruitment lists for each of the group activities based on the sampling frame, and provided them to the lead fieldworker who made home-visits to those listed. The aim was to recruit a total of between eight and twelve participants for each activity. An excess of purposively sampled participants was included on the recruitment lists in order to account for participants declining to participate, being away from home or having moved out of the study area at the time of invitation. Invitations were delivered verbally; the aims of the group activities were explained, and the time, date and location for the session were provided, with sessions usually occurring within two days of the day of invitation. In total 48 purposively sampled men and women were invited to participate. Of these, 40 attended and 32 brought a friend or neighbour who also participated, giving a total of 72 participants (41 men and 31 women).

7.5.2 IDIs with HTC users

The majority of HTC users participating in IDIs were recruited via the group activities. At the end of the activity, each participant was seen individually in order to compensate them for their time (5,000 Tanzanian shillings, approximately 3 US dollars) and give them the opportunity to ask any questions confidentially. In addition, those individuals who had been included as 'seeded' HTC users were asked whether they were willing to disclose whether they had previously been for HTC. If the participant agreed and disclosed previous HTC use, s/he was asked whether s/he would like to participate in an IDI on experiences of going for HTC. Interviews were usually held the next day at a location of the participants choosing (often the same location where PLA activity had been conducted). In total 25 participants (13 women and 12 men) were invited to take part via the group activities and all attended for interview.

Due to small numbers of seeded HIV-positive HTC users, some HIV-positive individuals were recruited for IDIs via the HIV care and treatment clinic (CTC) at Kisesa Health Centre. Clinical staff were briefed on the aims and objectives of the study, and invited patients attending routine clinic appointments to participate. In total six HIV-positive individuals (three men and three women) were invited and agreed to be interviewed. A time, date and location for the interview was agreed and these details were passed to the research team. All but one individual (a woman) recruited via the CTC subsequently attended for interview.

7.5.3 IDIs with healthcare workers

Healthcare workers involved in the provision of HTC were sampled purposively in order to obtain perspectives from individuals offering different types of services. This included two counsellors working at the walk-in HTC or VCT clinic at Kisesa Health Centre, two healthcare workers offering PITC at the health centre's antenatal clinic, and one member of the District Health Management Team who provided training, supervision and support for HTC counsellors. These individuals were approached by the lead research assistant, informed about the aims of the study and invited to participate in an IDI relating to their experiences of providing HTC or of offering training for counsellors. All interviews were conducted by the research assistants in Swahili, and were held at Kisesa Health Centre, NIMR Mwanza or in the case of the HTC trainer, at Magu District Hospital.

7.6 Data collection

A total of nine participatory group activities with 6 to 12 participants each were carried out, stratified by gender (four with women – stratified by age group (18-34 or 35-60 years) and rural or urban area of residence. Five with men – similarly stratified by age group and area of residence. Two group activities were carried out with men from urban villages in the older age-group, due to low attendance (five participants) and limited contributions during the first activity).

Following informed consent, group activities were audio-recorded; recordings were later transcribed and translated into English. Activities were facilitated by same sex researchers in Swahili, and a note-taker (also matched on gender) kept detailed

notes which were subsequently typed up in English and shared with the research team. The group activities were conducted at NIMR field offices near Kisesa Health Centre for community members from urban villages, and in an empty cotton storage barn in Ihayabugaya for participants from rural villages. I sat in as an observer during all of the group activities, and conducted de-briefing sessions with the research assistants at the end of each activity.

In total 30 IDIs were conducted with users of HTC services (15 men – 10 HIV-negative and five HIV-positive, 15 women – 10 HIV-negative and five HIV-positive) while five IDIs with healthcare providers were completed. Research assistants were matched to study participants on gender in all cases with the exception of the IDI with the HTC trainer (a woman who was interviewed by a man. This was not expected to affect data collection as topics covered during interviews with healthcare workers were not of a private or personal nature). Interviews were conducted in Swahili, audio-recorded and subsequently transcribed and translated into English. I did not observe the IDIs with HTC users or healthcare workers due to the private nature of the information shared during IDIs with HTC users, and because it was felt that the presence of a foreign researcher in the context of a one-on-one interview may have resulted in social desirability or other biases (for interviews with both HTC users and healthcare workers). However, I carried out de-briefing sessions with research assistants at the end of all IDIs. This allowed additional probes around important topics to be included in IDI discussion guides, in order to improve the depth and quality of the data collected.

7.7 Ethical considerations

Ethical approval for this qualitative study was obtained from the ethics committee of the LSHTM and from the Tanzanian Medical Research Coordinating Committee (see Appendix 11.1.3). Prior to starting each study activity, the session's aims and content were explained by the research assistants in full. Verbal consent was obtained for participation and audio-recording of the group activities. Written or verbal consent was obtained during IDIs, dependant on the writing ability of participants.

Study participants were informed that they could decline to answer any question during the group activities or IDIs, or that they could leave the group discussion or terminate individual interviews at any time. All participants were compensated for their time (5,000 Tanzanian shillings (approximately 3 US dollars) for group activity participants or IDIs with HTC-users, 10,000 shillings (approximately 6 US dollars) for healthcare workers, in line with other qualitative studies conducted in Kisesa). During the group activities, participants were informed that the discussions would be general and that they were not expected to share any personal information regarding prior use of HTC services. Participants chose fictitious names (such as the name of an animal or fruit) to use during the group discussions in order to protect their anonymity. All study documentation was labelled with codes; names were not recorded on audio-files or interview transcripts, nor referred to in quotations. Digital files were stored on my personal laptop or a secure server at the LSHTM, with password restricted access.

During group activities, the seeded focus group approach allowed me to include both users and non-users of HTC, while concealing the HTC-use and HIV status of participants from both research assistants and other study participants, and providing a convenient sampling frame for the recruitment of HTC users for IDIs. At the point of recruitment for IDIs (i.e. when group participants were seen individually at the end of each activity), research assistants became aware of the HTC use status of participants. However, research assistants were unaware of the HIV-status of HTC-users recruited for IDIs via the group activities unless participants chose to disclose this during the interview. Before agreeing to participate, HIV-positive individuals recruited for IDIs at Kisesa Health Centre were informed that research assistants would be aware of their HIV-status by nature of the fact that they were recruited at the CTC, but were free to decline participation.

7.8 Data analysis

Data analysis was guided by a framework approach, drawing on *a priori* concepts drawn from theories of behaviour change and from existing literature, but also reflecting the accounts and observations of study participants (178). After transcription and translation, the first stage of analysis involved familiarisation with the data by reading through transcripts and creating summary notes for each group

activity and IDI. I also referred to study notes taken during fieldwork, including notes written up by myself and by the research assistants after each group activity, and the detailed de-briefing notes taken after IDIs. These summaries were synthesized in charts in Excel, which I used to compare emerging themes across cases (i.e. comparing views on similar topics expressed by different PLA groups or IDI participants). Analytical memos were also used to explore emerging concepts by identifying prominent themes among sub-groups of participants by age-group and gender.

Coding was carried out in Nvivo10, guided by a theoretical framework which was adapted from an individual level model of behaviour change (128). Codes were also generated inductively, grounded in the accounts of study participants. The initial coding frame developed after coding the first five transcripts was reviewed by study co-authors (Alison Wringe, Joyce Wamoyi, Shelley Lees). The codes were then refined according to emerging concepts, and grouped under overarching themes. The refined coding frame was then applied to all transcripts. Data were then synthesized, distilling the coding to explore the emerging patterns and meanings in terms of sexual behaviour change and HIV-prevention, and to provide explanations for findings

8 Paper D. 'It is just the way it was in the past before I went to test': responses to HIV prevention counselling messages in rural Tanzania.

Introduction to the paper

To contextualise and complement the quantitative analyses presented in Chapter 6, which assessed the impact of the sero-survey VCT service on reported changes in sexual risk behaviour and HIV-incidence, a qualitative study was conducted in order to understand perceptions of HTC services, and how HIV prevention counselling messages might influence attitudes and intentions regarding sexual risk reduction. It was expected that these data might shed light on the factors shaping sexual behaviour change following HTC use, and thus provide possible explanations for quantitative findings. While a number of qualitative studies have explored responses to HIV-prevention counselling messages among individuals testing HIV-positive in sub-Saharan Africa (26-29, 131), few have included clients testing HIV-negative, and this was a strength of the data presented in this paper. The findings from the quantitative and qualitative analyses of the impact of HTC on sexual behaviour change are synthesised and compared in the thesis discussion (Chapter 9).

RESEARCH PAPER COVER SHEET

PLEASE NOTE THAT A COVER SHEET MUST BE COMPLETED FOR EACH RESEARCH PAPER INCLUDED IN A THESIS.

SECTION A – Student Details

Student	Caoimhe Cawley
Principal Supervisor	Alison Wringe
Thesis Title	Understanding the role of HIV testing and counselling services in HIV prevention in rural Tanzania

If the Research Paper has previously been published please complete Section B, if not please move to Section C

SECTION B – Paper already published

Where was the work published?			
When was the work published?			
If the work was published prior to registration for your research degree, give a brief rationale for its inclusion			
Have you retained the copyright for the work?*	Choose an item.	Was the work subject to academic peer review?	Choose an item.

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SECTION C – Prepared for publication, but not yet published

Where is the work intended to be published?	AIDS and Behavior
Please list the paper's authors in the intended authorship order:	Caoimhe Cawley, Alison Wringe, Shelley Lees, Joyce Wamoyi, Mark Urassa
Stage of publication	Submitted

SECTION D – Multi-authored work

For multi-authored work, give full details of your role in the research included in the paper and in the preparation of the paper. (Attach a further sheet if necessary)	I designed and conducted the study. I trained the fieldworkers (in collaboration with JW), designed the data collection tools, managed the fieldwork, analysed the data and wrote the manuscript.
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Student Signature:



Date: 14/04/2015

Supervisor Signature:



Date: 14/04/2015

8.1 Abstract

This qualitative study explored the nature and content of HIV testing and counselling sessions with a view to understanding their potential role in reducing sexual risk-taking. Nine sex-specific participatory group activities were completed, in addition to 30 in-depth interviews (IDIs) with HTC clients and five IDIs with healthcare workers. Data collection activities were conducted in Swahili, audio-recorded, transcribed, and translated into English. Nvivo10 was used to code and analyse transcripts, guided by a framework approach. Emerging themes included structural and socio-cultural factors, including poverty, sexual decision-making and relationship dynamics, which constrained the extent to which HIV-negative individuals, but particularly HIV-negative women, felt that they could control their HIV-risk, which was seen as inherently linked to their partners' sexual relationships. The findings also suggested that counselling messages were perceived by clients as dictated 'instructions' which were rarely tailored to their circumstances, while providers reported feeling ill-equipped to deliver effective prevention messages. HIV prevention counselling is unlikely to significantly contribute to risk reduction unless counselling messages are generated through more equitable client-counsellor interactions which acknowledge prevailing socio-cultural norms.

8.2 Introduction

Counselling is assumed to form a critical component of the HIV testing and counselling (HTC) process, being performed both before and after testing, and giving clients an opportunity to consider their sexual behaviour and discuss an individualised risk-reduction plan with counsellors (45). Essential to this is the sharing of personal information by the client with the counsellor, and the joint identification of potential risks and possible strategies to reduce them (4-6).

There has been a widespread assumption that in African settings, counselling in the context of undergoing an HIV test can encourage reductions in sexual risk behaviours such as multiple concurrent partnerships (179) or low levels of condom use (173). However, quantitative evidence to support the role of HTC in sexual behaviour change in sub-Saharan Africa is mixed, particularly among HIV negative individuals (22, 23). To date, much of the body of qualitative research around HTC use in African settings has focussed on barriers or facilitating factors to the uptake of services (180), rather than how counselling messages might be perceived, understood or acted upon by clients. Some qualitative studies have explored sexual risk reduction among HIV-positive individuals or sero-discordant couples following HTC (28, 129, 181), however few have focussed on HIV-negative individuals (130).

In order to better understand the processes through which HTC may contribute to sexual behaviour change and HIV prevention, we conducted a qualitative study to explore community perceptions of HTC services as well as HIV-negative and HIV-positive clients' understandings of counselling messages following either voluntary counselling and testing (VCT) or antenatal provider-initiated testing and counselling (PITC) in a rural area of northwest Tanzania.

Theoretical perspectives

HTC is an intervention targeted at the level of the individual (or within the unit of a couple, where couple counselling is offered), however there is a paucity of evidence to guide the theoretical constructs upon which HIV prevention counselling is expected to act in African settings. Many models of behaviour change were developed in Western settings, focusing on individual attributes such as individual

intentions, attitudes and feelings of self-efficacy, generally paying little attention to broader social or environmental determinants of behaviour (113). However, social and cultural norms and expectations as well as structural factors such as poverty are likely to shape behaviour in African settings, where identity is strongly influenced by family, community and other social factors (115). In Tanzania, VCT training manuals highlight a variety of approaches which may encourage individual-level behaviour change, such as approaches based on behavioural or cognitive theory (182), although the constructs within these theories, and particularly how they might translate into HIV-prevention counselling advice, are not well described.

8.3 Methods

8.3.1 Study design and setting

This study was carried out within the context of a community HIV cohort study in Kisesa in rural northwest Tanzania, where regular rounds of demographic and HIV serological surveillance have been ongoing since 1994 (150). HIV prevalence in the study area was estimated at 6.5% in 2010, with most participant's revenue coming from small-scale subsistence farming. HTC services were first provided in the study area as part of serological surveillance during 2003-2004, with further provision of HTC during three additional rounds of serological surveillance between 2006 and 2013. A permanent VCT clinic opened within the study area's main health centre in 2005, with PITC services offered routinely to pregnant women from the end of 2008. Temporary outreach VCT services are occasionally provided in the study area by government hospitals or non-governmental organisations. Although they have improved over time, rates of HTC uptake in Kisesa remain low, with lifetime coverage of testing being approximately 40% among men and 50% among women by 2010 (152).

Qualitative data collection took place between February and April 2012, and different methods were used in order to maximise learning from different perspectives. Nine group activities were conducted incorporating participatory learning and action (PLA) activities, which integrate data collection with an exchange of information between researchers and participants and can help to mobilise support around relevant issues (175, 176). Thirty in-depth interviews (IDIs) with HIV-negative and HIV-positive service users explored individual experiences of

completing HTC, while five IDIs were carried out with nurses or counsellors offering HTC.

8.3.2 Sampling, recruitment and data collection

PLA activities were carried out with four female and five male groups of six to twelve participants, stratified by rural or urban residence and age-group (18-34 or 35-60 years). A combination of purposive sampling and snowball techniques were used to recruit participants. First, four to six individuals were purposively selected from a sampling frame constructed from the demographic and sero-surveillance datasets, which included some individuals who were known or reported to have used HTC services as well as some who had not used HTC. This 'seeded' focus group approach (177) allowed us to include HTC clients in the group activities without inadvertently revealing their HTC-use status to other study participants. Next, each purposively sampled individual was asked to invite a neighbour or friend from their village and from the same age group to participate. In total 48 purposively sampled men and women were invited to participate, of whom 40 attended and 32 brought a friend or neighbour, resulting in a total of 72 participants (41 men and 31 women). The PLA activities included brainstorming activities using flip-chart paper to express ideas and opinions relating to the perceived usefulness of HTC services, positive and negative aspects of service provision, and opinions relating to counsellors.

IDIs were carried out with 15 men and 15 women who had used HTC services, 10 of whom were HIV-positive (five men and five women). The majority of interviewees (n=25) were recruited via the group activities. At the end of the activity, each participant was asked privately whether s/he was willing to discuss previous use of HTC. If the participant agreed and was an HTC user, s/he was invited to participate in an IDI on experiences of going for HTC. The discussion guide included topics on motivations for going for HTC, impressions of counsellors, information and advice shared with and received from counsellors, attitudes and feelings regarding the counselling advice received and regarding sexual risk reduction, and experiences of disclosing HTC use to partners or other family members. Five HIV-positive individuals were recruited for IDIs via the HIV care and treatment clinic (CTC) at Kisesa health centre, due to small numbers of seeded HIV-positive HTC users.

The characteristics of the 30 HTC clients who completed IDIs are shown in Table 8.1. Most clients had received their most recent HTC at the walk-in VCT clinic at Kisesa Health Centre, and had tested within the last year. In total 18 were HIV-negative, 10 were HIV-positive and two were of unknown HIV status.

Five IDIs were carried out with healthcare workers, purposively sampled to include individuals providing VCT (n=2), PITC at the ANC (n=2), and one member of the District Health Management Team who provided training, supervision and support for counsellors. Topic guides for healthcare workers providing HTC services included length of time and experience providing HTC, the content and information shared during pre and post-test counselling sessions, community perceptions of HTC, and levels of training and support received. The IDI with the HTC trainer covered issues relating to the content of counsellor training programmes, as well as ongoing professional development, support and supervision for counsellors.

All group activities and IDIs were conducted in Swahili by same gender researchers, with the exception of the IDI with the HTC trainer (a woman who was interviewed by a man). Study activities were audio-recorded following consent from participants, and then transcribed and translated into English. Debriefing interviews were held in English with field workers after each group activity and IDI in order to discuss preliminary findings.

Table 8.1 Characteristics of HTC users participating in IDIs

	Male (n=15)	Female (n=15)
Age group		
18-24	4 (26.7%)	3 (20%)
25-34	2 (13.3%)	4 (26.7%)
35-44	4 (26.7%)	4 (26.7%)
≥45	5 (33.3%)	4 (26.7%)
Location of most recent HTC		
Community outreach-VCT (during sero-survey)	1 (6.7%)	-
Walk-in VCT clinic (Kisesa health centre)	8 (53.3%)	9 (60%)
Other VCT*	4 (26.7%)	3 (20%)
Antenatal PITC	-	3 (20%)
Unknown	2 (13.3%)	-
Time since most recent HTC		
≤1 year	9 (60%)	7 (46.7%)
2-4 years	4 (26.7%)	3 (20%)
>4 years	-	4 (26.7%)
Unknown	2 (13.3%)	1 (6.7%)
HIV Status		
Negative	9 (60%)	9 (60%)
Positive	5 (33.3%)	5 (33.3%)
Unknown	1 (6.7%)	1 (6.7%)
Area of residence		
Rural	7 (46.7%)	9 (60%)
Trading centre (urban)	8 (53.3%)	6 (40%)
Level of education		
None	1 (6.7%)	-
Primary	7 (46.7%)	13 (86.7%)
Secondary or higher	7 (46.7%)	2 (13.3%)
Unknown	-	-
Marital status		
Married monogamous	7 (46.7%)	9 (60%)
Married polygamous	1 (6.7%)	-
Separated/divorced	2 (13.3%)	2 (13.3%)
Widowed	2 (13.3%)	3 (20%)
Single (never married)	3 (20%)	1 (6.7%)

*Other outreach VCT service within Kisesa, or VCT service outside Kisesa ward

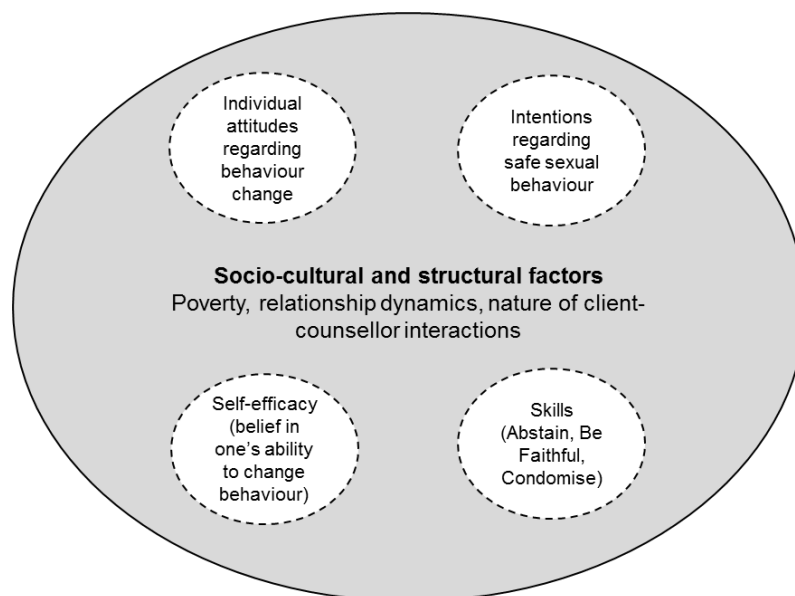
8.3.3 Ethical considerations

This study was approved by the ethics committees of the Tanzanian Medical Research Coordinating Committee and the London School of Hygiene and Tropical Medicine. During group activities verbal consent was obtained, while for IDIs the option of verbal or written consent was offered. Fictitious names were used during group activities to safeguard anonymity, and participants were advised that they were not expected to share personal information, particularly with regard to HIV-status or prior HTC use. Recruitment procedures for IDIs using the seeded focus group approach were designed to maximise confidentiality and avoid any inadvertent disclosure of HTC use status. Some 'seeded' HTC users were HIV-positive, however field workers were unaware of the HIV status of any participants unless they chose to disclose this during IDIs. For HTC-users recruited via the CTC, prior to agreeing to participate patients were informed that interviewers would be aware of their HIV-status, due to the nature of their recruitment.

8.3.4 Data and analysis

Coding and analysis of transcripts was carried out in Nvivo10, guided by a framework approach (178). After familiarisation with the data, an initial coding frame was developed, drawing on concepts derived from the theories of behaviour change. As it paid some attention to socio-cultural and environmental influences on behaviour, an adapted version of an integrated model of individual level behaviour change (128) was used to guide data analysis (Figure 8.1). Codes were also generated inductively, grounded in the accounts of study participants. The initial coding frame developed by the lead author (CC) was reviewed by co-authors (AW, SL and JW) and revised according to emerging concepts, which were grouped under overarching themes. The refined coding-frame was then applied to all transcripts. Data were then synthesized, distilling the coding to explore the emerging patterns and meanings in terms of sexual behaviour change and HIV-prevention, and to provide explanations for findings.

Figure 8.1 Conceptual framework for understanding responses to HIV prevention counselling messages in rural Tanzania



8.4 Results

Two major themes emerged in understanding responses to HIV prevention counselling messages in Kisesa. These revolved around socio-cultural and structural factors, including sexual decision making and relationship dynamics, and the nature of client-counsellor interactions, both set against a general background of poverty and economic insecurity. We found only moderate evidence that individual attributes such as intentions and feelings of self-efficacy had an impact on behavioural change following HTC, as their influence was consistently affected by the broader social contextual factors that shaped participants' lives. Findings are presented below in each of the two key thematic areas which emerged.

8.4.1 Sexual decision making and relationship dynamics

Both men and women were appreciative of HTC and reported feeling supported after using the service, regardless of whether they tested HIV-negative or HIV-positive. In IDIs, participants tended to report that they were already implementing, or planned to implement in the future, the advice they had received from counsellors. However, suspicions of partner infidelity were reported by both men and women, and many participants reported feeling at risk of HIV as a result of their partner's rather than their own behaviour. This implied a certain futility in attempting to change behaviour without the support and commitment of one's partner.

There was time my wife travelled...I didn't see any reason for her to stay there for a month. So that issue made me to be very worried that why should she stay there for a whole month...what is she doing? (IDI 11, HIV-negative man 35-60 years).

Now he was always travelling because he was a driver. Yeah, whenever he came home he could stay only for a week then leave, He could leave for almost two months, you see. So it wasn't easy to get information about him. Perhaps he was doing things from there. (IDI 23, HIV-positive woman 35-60 years).

In particular, women reported that it was expected or accepted that men could have multiple partners, and seemed to imply there was a certain inevitability to their partners' infidelity. Women also reported difficulties getting their partners to commit to or engage in discussions about sexual risk reduction.

You should get home and start telling your partner. He listens to you during that time but after some time he forgets about it. He starts doing the same thing. (IDI 3, HIV-negative woman 18-34 years).

For women, partnerships commonly represented a source of financial support upon which they were dependant, particularly where there were children to care for. They seemed to deal with competing risks – that of potential exposure to HIV-risk on one hand, or loss of economic support on the other. This seemed to limit their choices in terms of sexual risk reduction.

Even if you move out here and go to another man you will face the same problem. You have children too. Where will you go around with the children up to? You must stay by persevering. (IDI 3, HIV-negative woman 18-34 years).

HTC clients were consistent in reporting that they had received 'ABC' messages from counsellors (abstain from sex, be faithful to one partner and/or use condoms). However, most participants were already married or in a sexual partnership, and abstinence was not generally perceived as a realistic or desirable option. In addition, the desire to have children was occasionally reported as interfering with clients'

abilities to follow counselling advice. Abstinence seemed most likely among HIV-positive individuals, many of whom reported having reduced their frequency of sex, or were not sexually active anymore, mainly because they had separated from their partners after diagnosis, or had chosen not to re-marry after a partner had died.

I have never touched any woman ever since my wife died. Many people were advising me that why don't you marry another woman, but I refused. The problem might bring up more problems to my health. It is better if I go on with the treatment. (IDI 29, HIV-positive man 35-60 years).

Only a small number of clients reported that they had ever used condoms, which were often perceived as relevant for use outside but not within marriage. Women and female counsellors also reported that condoms were disliked by men. One woman recounted that she did not use condoms with her husband, instead placing her faith in God to protect her from HIV, again suggesting limited choices for women in terms of reducing their exposure to risk.

Now if it is your husband will you again use protection, why should you use protection with your husband? That is you have to leave it to God now...When you decide to get married to him it is like you trust him. (Female group activity participant, age-group 18-34, rural residence).

He [the client] might say ... I am not used to that kind of protection. Ever since I married I have never used it. ... Many people especially the men don't want to use the condom. (IDI 33, healthcare worker number 3).

One HIV-negative woman cited multiple reasons why she had never used condoms, including that she was afraid to use them because they might be second-hand or re-used, although it seemed that a greater barrier to condom use may have been men's reluctance to use them.

He [the counsellor] asked if I have ever used the condom, then I replied that I hadn't.... There was not enough elaboration because some of us can't use protection. It is because some people say it is bad. There are some that are already used; now you also just fear to use protection too.... Some men also don't want to use the condoms. When you give him the condom he receives it but pricks it at the end. (IDI 8, HIV-negative female, 18-34 years).

Participants sometimes reported positive attitudes and intentions regarding sexual risk reduction following HTC, but that despite this, temptations could lead one to engage in high risk behaviours. This was sometimes linked to the consumption of alcohol, but also cited as normal behaviour, with desire sometimes overriding 'rational' decisions. It was also given as a reason to go for HTC often, in order to be reminded and motivated to avoid high risk behaviours.

It is because there are many temptations if you consider the fact that you were guided and counselled once...Going once doesn't help, you can forget and you might have done something that is not worth to be done. (IDI18, HIV-negative man 18-34 years).

Several HIV-negative participants reported disclosing their use of HTC and HIV-status to their partners, with some participants reporting having taken home a test card or certificate in order to prove this. However, this rarely seemed to lead to further discussions within the couple about potential exposure to HIV-infection, or joint plans for sexual risk reduction. Only a small number of participants reported that they had gone for couples HTC. These participants generally reported positive experiences and suggested that joint counselling might help to obtain commitment to behaviour change by both members of the couple (although in all cases both partners had tested HIV-negative).

Maybe that is where we get enlightened and be able to say that, we are both mobilised. It is not that I get motivated alone. (IDI 3, HIV-negative female 18-34 years).

8.4.2 Dynamics of client-counsellor interactions

There were apparent barriers to clients sharing details of their private sexual lives with counsellors. This limited the potential contribution of HTC in terms of clients and counsellors being able to jointly identify and discuss possible risk reduction strategies. The barriers seemed to at least partly relate to the hierarchical nature of the relationship between client and healthcare provider. Counsellors were frequently referred to as 'experts' who should lead and direct conversations, with clients listening or adhering to 'instructions' which were received. However, it was also

expressed that it was difficult to share private and personal information with counsellors due to the sensitive nature of the subject matter, particularly in the case of one woman who was counselled by a man:

Interviewer: What did you talk to him [the counsellor] about?

Respondent: It is him who was asking as I answer...Actually I never thought in my mind to ask him any question... in general it was hard to tell a man. We could talk about other things but for...mmm it is difficult. It is just fear to tell the male counsellor, because all men are... they are of the same calibre. If it were a female I would have told her. (IDI 8, HIV-negative female, 18-34 years).

In the risk assessment she [the client] talked but she was not able to put it open that she had intercourse contrary to the way it was supposed to be done. (IDI 31, healthcare worker number 1).

Counsellors recounted their efforts to build rapport with clients and to help them identify possible solutions to their problems, although one counsellor acknowledged the limitations of counselling, inferring that sexual behaviour was complex and that some issues were difficult to 'solve'.

The client should be the main speaker, the counsellor should be the listener, she should direct the client to be able to realize his problem, and know how to solve it. If it is not a problem that can be solved then he should know how he will continue to live with it, because not all problems can be solved, there are some problems that are difficult to solve. (IDI 31, healthcare worker number 1).

However, there was also evidence that healthcare workers tended to be authoritative and directive in their counselling, instructing clients to behave in certain preferred or 'correct' ways (usually being faithful to one partner, or using condoms).

You have to ensure that somebody has understood....It is until he repeats everything that you have said.... and then if you realize that it is correct, then he would have understood.... You continue to advise him that it is supposed to be like this and this (IDI 33, healthcare worker number 3).

Several participants implied that it was the testing aspect of the service, rather than the counselling offered, which was most useful. One young woman described that not much had changed in her relationship after going for HTC, despite the fact that she suspected her husband of being unfaithful, but that she planned to test again the next month, and found the testing process reassuring as a way to check up on her HIV status.

It is just the way it was in the past before I went to test... I just encouraged myself for the next month to come to go and test to be able to check my health status so as to continue protecting myself. (IDI 1, HIV-negative woman 18-34 years).

In general counsellors were viewed by clients in a positive light, however occasionally concerns were raised that the services provided were poor or that healthcare workers were 'harsh' or 'impatient'. During one group activity, male participants referred to rumours that some counsellors did not respect privacy and 'gossiped' about patients, and this may have affected client willingness to share personal information with counsellors. Other participants stated that they felt counsellors were professional and confidential, but that a client's HIV status could sometimes be deduced by other patients in the waiting room, if an individual spent a long time with the counsellor (assumed to be HIV-positive). This may make clients reluctant to spend lengthy periods with the counsellor, for fear others might suspect them of being HIV-positive.

During PLAs, several participants raised concerns that the counselling rooms at the health centre were not sufficiently private and that conversations between counsellors and clients might be overheard by other patients or staff. This inhibited communication and was particularly a problem at the ANC, where HTC sessions were conducted in an only partially private area.

Now right there even if somebody [a pregnant woman] is being guided and counselled the one beside her will hear it. So it would have been better if she was given her own room as the counsellor. (Female group activity participant, age-group 18-34, urban residence).

If the nurse and the patient talk loudly, the other people might hear. But if we had a room that was covered like this one, you could talk to the mother inside here very well. (IDI 32, healthcare worker number 2).

Only a few clients reported their experiences receiving antenatal PITC. Their accounts of the types of counselling messages they received did not differ greatly from women who attended the VCT clinic, except for one woman who reported that she was tested with very little pre or post-test counselling. This is concerning in terms of missed opportunities to provide counselling on sexual risk reduction and on reducing the risk of mother-to-child transmission of HIV, as well as in terms of compliance with procedures for informed consent.

Counsellors reported that a significant challenge they faced was an insufficient level of training, including training courses which were too short, and refresher trainings which were rarely given. Counsellors intimated that more extensive training sessions might have helped them to better grasp the content of training sessions.

That time was not enough... There were many things to be learnt in two weeks... So they should have made it to be one month. It will have been better because we could learn slowly. And put all the things straight. Or the refresher courses should be there, so that people can be reminded. (IDI 33, healthcare worker number 3).

Another challenge highlighted by counsellors related to shortages of HIV test-kit supplies, meaning that counsellors sometimes had to close the VCT clinic or turn away clients wishing to test at the VCT or ANC. This was a source of stress to counsellors, and compromised clients' trust in healthcare services, which may negatively affect perceptions of the quality of the counselling advice received.

The level of mobilization is very low, I say it is small because the services provided here are seasonal, even though there is a centre here every day but you get that they are never there. (IDI 20, HIV-negative man 18-34 years).

8.5 Discussion

Initial approaches to HTC were developed in Western contexts, where individual attributes, such as individual intentions and feelings of self-efficacy, are relatively more important determinants of health behaviours than in non-Western cultures (115). In a rural Tanzanian setting, we found that while clients tended to report positive intentions regarding sexual risk reduction following HTC, socio-cultural and structural barriers were of greater significance in influencing behavioural outcomes.

In particular, sexual decision-making and relationship dynamics were important in shaping responses to HIV counselling messages. HIV-positive individuals generally expressed greater self-efficacy in reducing sexual risk behaviour following HTC, at least in terms of the reported frequency of sex, while HIV-negative individuals implied that they were at risk of HIV as a result of their partners' rather than their own behaviour. Women appeared particularly constrained in their ability to control their exposure to HIV-related risk, being economically dependent on male partners who were not always willing to engage in discussions regarding sexual risk reduction. A number of studies in northwest Tanzania have highlighted the dominant role of men in sexual decision making within relationships (174) and the significance of male multiple partnerships in determining masculinity and social status (183, 184). We similarly found that women appeared limited in their ability to enact sexual behaviour change without getting the agreement or support of their partner, and that women reported that it was expected or accepted for men to have multiple partners. Some women reported testing frequently in order to learn whether they had become infected, demonstrating a certain level of self-efficacy, at least in terms of the choice to attend for testing, however this seemed unlikely to affect sexual behaviour change or women's level of exposure to risk.

Condoms were perceived by women and by female counsellors as being disliked by men, and were viewed by both male and female IDI participants as appropriate for use with short term or casual partners, but not within marriage. Other studies in East Africa have found that condoms were only used during the initial stages of relationships (26), that suggesting their use in more stable or committed partnerships could raise suspicions of infidelity (27), and that as a male controlled technology, women often found it difficult to negotiate their use (185). Other studies

in Tanzania have reported male preferences for sex without condoms (173, 174), and in our study their use was reportedly limited, at least within steady or committed partnerships. As a result, their effectiveness as an HIV prevention intervention seems somewhat limited in this setting.

Only a few clients reported having gone for testing together with their partner, however some expressed a desire to do so. The few individuals who reported having gone for couples-HTC reported positive experiences, including that couples might get 'motivated' together. In support of this, one Zambian study reported that although couple testing did not always lead to safe sex, it helped to renew commitment to the relationship and aided women in negotiating safe sex, as discussions were mediated by a counsellor (132).

In their accounts of interactions with counsellors, participants referred to counselling advice as 'instructions' to be followed, challenging the notion of counselling as a two-way process during which detailed personal information was shared and potential HIV-prevention strategies were jointly identified and discussed. Similar findings were reported in another study in Uganda, where clients reported complying with 'rules' rather than sharing more intimate thoughts with counsellors (186), and one study in South Africa noted that counsellors tended to use one of two main strategies when delivering counselling advice, which included either 'making appeals' to clients or 'prescribing rules for living' (187). The authors noted that the former strategy seemed more effective in encouraging clients to consider their own behaviour by engaging them more fully in discussions. In this study, some counsellors recounted their efforts to help clients identify possible solutions to their own problems, although counsellors were also directive and authoritative, demonstrating an imbalanced client-counsellor relationship which has previously been noted in Kisesa (58). The limited extent and availability of training may have limited counsellors' abilities in engendering more engaged discussions with clients.

A few clients reported that counsellors were sometimes 'harsh', and this may have affected client willingness to share personal information, while client-counsellor interactions may also have been constrained by the sensitive nature of the subject matter and/or client concerns about confidentiality. Several clients reported finding

the process of learning their HIV status reassuring in itself, regardless of counselling messages received, however this knowledge alone seemed unlikely to lead to changes in sexual risk behaviour. Previous studies have suggested that 'de-linking' testing and counselling service provision might help clients to focus on counselling messages and thus more effectively support behaviour change (130, 137), but this hypothesis remains untested.

Airhihenbuwa & Obregon propose that in non-Western cultures, family and community are more central to the construction of health and well-being than the individual (115). In support of this, one study reported that HIV-positive Ugandan men and women's main motivations in preventing HIV transmission were altruistic wishes to protect sexual partners and to avoid orphaning children (29). In African settings, counselling messages which include broader culturally relevant altruistic messages relating to partners, children and the wider community, for example emphasising the benefits of protecting unborn children from HIV, or of maintaining the integrity and health of the family unit, may be more successful than ones which focus solely on self-interest (29).

A limitation of this study was that HTC users may have been reluctant to share details of what was discussed with counsellors with study researchers, due to the sensitive nature of the topic and due a similar hierarchical relationship between participants and researchers to that observed between clients and counsellors. However, interviewing techniques to build rapport and trust with participants were addressed during fieldworker training. In order to maximise confidentiality, all IDIs were conducted either in private rooms near Kisesa Health Centre, or in the case of rural residents, in private locations near rural dispensaries, and researchers were matched to study participants on gender.

In conclusion, in the face of broader socio-cultural and socio-economic constraints, HIV prevention counselling alone based on a Western model of individual level agency is unlikely to make a significant contribution to sexual behaviour change in a rural setting such as Kisesa. More culturally relevant counselling messages and infrastructural improvements, such as additional training for counsellors and

counselling rooms which ensure privacy and confidentiality, may lead to better outcomes in terms of sexual risk reduction.

9 Discussion

This chapter includes a synthesis of the research that was undertaken in relation to each of the study objectives, combining the contributions from both quantitative and qualitative methods to give an overall presentation of key findings. It also highlights the strengths and limitations of the research, and discusses how policy and programme recommendations based on the findings will be conveyed to Tanzanian policymakers. Recommendations for future research are also highlighted, while the efforts taken to date to disseminate the research findings are summarised.

9.1 Synthesis of findings

In understanding the role of HTC services in HIV prevention in rural Tanzania, the study objectives fell under two broad areas of research. The first of these related to describing HTC uptake and coverage, with uptake being defined as usage of testing services, while coverage refers to the proportion of the population who have ever accessed testing services. The second area of research involved investigating the role of HTC in sexual behaviour change. The ultimate aim of the research conducted under both areas is to understand how to maximise the contribution of HTC to HIV prevention efforts in rural Tanzania and other similar settings in sub-Saharan Africa.

An adapted conceptual framework for the study based on the findings which emerged is shown in Figure 9.1. Quantitative methods were used to investigate the outcomes under the first area of research, which included describing the uptake and coverage of different types of HTC services, and identifying the proportions of individuals, and risk factors associated with, repeat testing. A mixed methods approach was used to investigate the outcomes under the second area of research, which included quantitatively assessing the evidence for an association between HTC use and reductions in sexual risk behaviour, and using qualitative methods to explore perceptions of HTC services and how HIV prevention counselling messages might influence or shape sexual behaviour change. While it had been expected that the qualitative study would contribute mainly to an understanding of the factors influencing sexual behaviour following HTC use, the findings from the qualitative research also highlighted factors which were important in understanding access to HTC services overall. Evidence for some factors influencing HTC uptake and

coverage, as well as sexual behaviour following HTC use, was found from both quantitative and qualitative analyses.

In the adapted conceptual framework shown in Figure 9.1, factors which were found to most strongly influence HTC uptake or sexual behaviour outcomes following HTC use are highlighted in bold, while those which were originally hypothesized to be important, but for which evidence was not found, are represented by text which has been struck-through. The colours signify whether evidence was found from quantitative (identified influences highlighted in blue) or qualitative research (identified influences highlighted in green), or from both (identified influences highlighted in purple).

The main findings from the study are summarised in Table 9.1 and synthesized under the two main areas of research in Section 9.1.1 and Section 9.1.2.

Figure 9.1 Adapted conceptual framework for understanding the role of HTC in HIV prevention in rural Tanzania

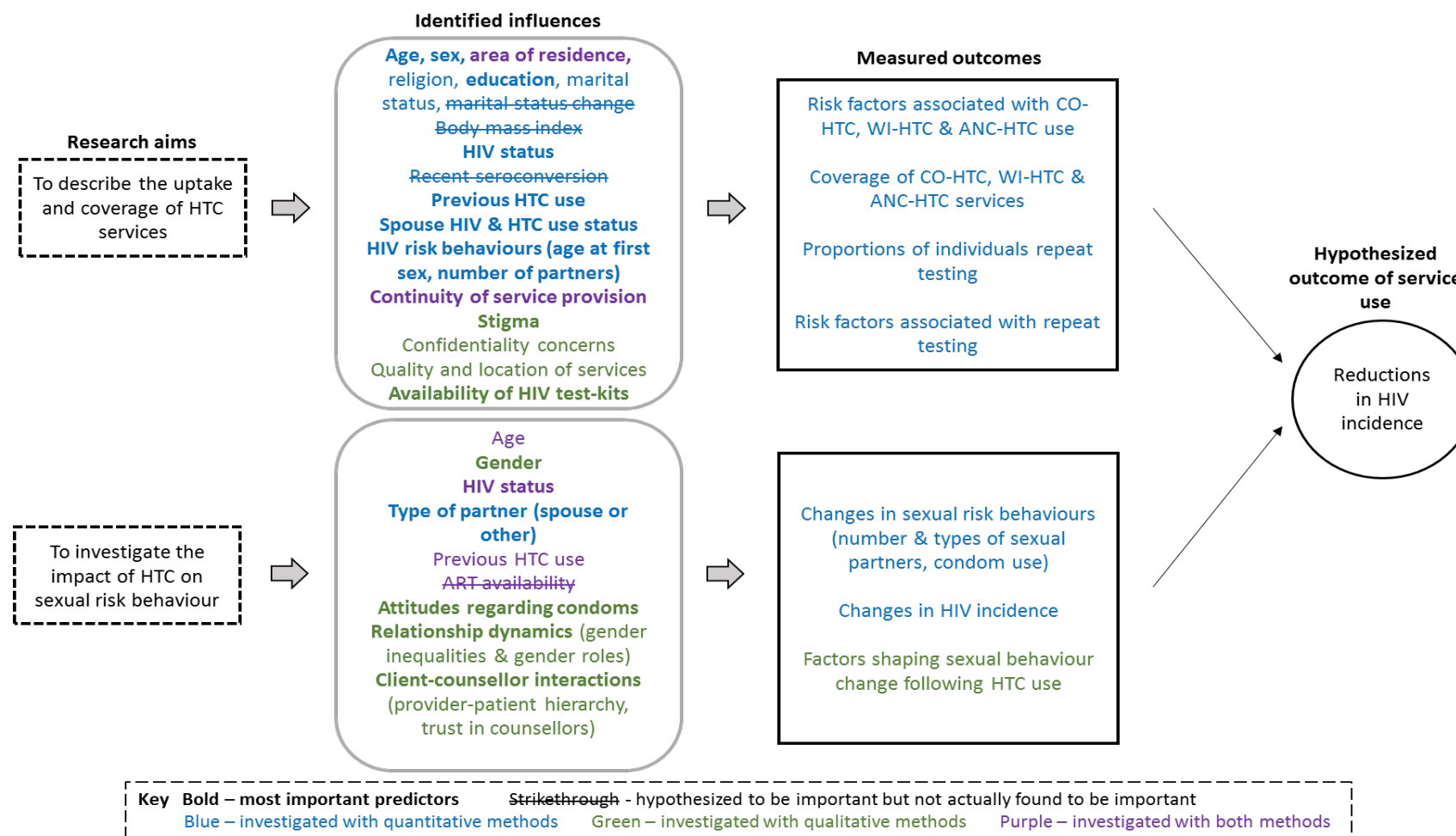


Table 9.1 Summary of main findings presented in the thesis

Chapter/Paper	Journal & date	Methods	Time frame of data collection	Main findings
Chapter 2 - Systematic review of the impact of HTC on sexual behaviour change and HIV incidence in sub-Saharan Africa	N/A	Systematic review of quantitative literature	2000-2014	HTC associated with increases in condom use and reductions in numbers of sexual partners among HIV-positive individuals. Impact among HIV-negative individuals less clear, with some studies reporting no statistically significant reductions (or increases) in sexual risk behaviour among this group. Only one study reported a statistically significant reduction in HIV incidence associated with HTC use
Chapter 4 (Paper A) - Risk factors for service use and trends in coverage of different HIV testing and counselling models in northwest Tanzania between 2003 and 2010	Submitted to TMIH March 2015	Quantitative analysis	2003-2010	Odds of attracting high-risk or infected individuals greatest at WI-HTC compared to CO-HTC or ANC-HTC. Overall proportion of infected persons diagnosed highest at CO-HTC.
Chapter 5 (Paper B) - Low rates of repeat HIV testing despite increased availability of antiretroviral therapy in rural Tanzania: findings from 2003-2010	Published in PLOS ONE April 2013	Quantitative analysis	2003-2010	Proportions of individuals using CO-HTC twice or more low (11%) among attendees of 3 sero-survey rounds. Age at first sex <15, polygyny and inconsistent condom use associated with repeat CO-HTC use. No association between HIV seroconversion and repeat CO-HTC but analysis restricted by small sample size
Chapter 6 (Paper C) - The impact of voluntary counselling and testing services on sexual behaviour change and HIV incidence: observations from a cohort study in rural Tanzania	Published in BMC Infectious Diseases March 2014	Quantitative analysis	2003-2010	CO-HTC associated with reductions in number of sexual partners and loss of non-cohabiting partners among HIV-negative individuals. No statistically significant associations between CO-HTC and changes in sexual behaviour among HIV-positive individuals, or changes in HIV incidence, possibly due to small sample sizes.
Chapter 8 (Paper D) - 'It is just the way it was in the past before I went to test': responses to HIV prevention counselling messages in rural Tanzania	Submitted to AIDS & Behavior April 2015	Qualitative analysis	2012	Responses to HIV-prevention counselling messages shaped by relationship dynamics which constrained the extent to which HIV-negative women felt able to control their HIV-risk. Imbalanced client-counsellor interactions limited communication during counselling sessions.

9.1.1 Uptake and coverage of HTC services

Increasing the uptake of HTC and identifying HIV-positive and high-risk individuals

Although there is an ongoing debate regarding the feasibility, acceptability and ethical aspects of potential TasP approaches in sub-Saharan Africa (147, 157, 188), the weight of the evidence and opinion among international public health organisations such as the WHO and UNAIDS is shifting in support of earlier access to ART for HIV-positive individuals, both for their own health and as an HIV prevention intervention (33, 35, 82). Critical to this will be considerable increases in the number of individuals accessing HTC services (and doing so regularly if they are sexually active and HIV-negative), as the point of diagnosis and entry into care.

In Tanzania, AIDS Indicator Surveys (AIS) have shown that despite considerable progress, rates of HTC uptake remain suboptimal. Nationally 47% of men and 62% of women reported ever having tested for HIV in the 2011-2012 AIS, while the corresponding averages for rural areas were 44% for men and 60% for women (15). In Kisesa, as shown in Chapters 4 and 5, although HTC use increased over time, by the Sero6 round in 2010, only 41% (1,269/3,108) of male participants and 52% (2,507/4,861) of female participants had ever tested for HIV, either at the community outreach (CO-HTC) service offered during sero-surveys or elsewhere within or outside the study area. This shows a somewhat lower uptake of services in Kisesa compared to the national average as well as the average for rural areas, despite the additional opportunities to test afforded by the research activities. The 2011-2012 AIS showed a lower overall uptake of HTC in rural as compared to urban areas in Tanzania (15), and this likely relates to greater barriers to the uptake of HIV services in rural communities, possibly as a result of differences in levels of HIV-related stigma and discrimination, higher levels of poverty and economic insecurity in rural areas, shortages of human and other resources, and poorer health system infrastructures.

The analyses presented in Chapter 4 revealed that compared to community outreach HTC (CO-HTC) and antenatal testing of pregnant women (ANC-HTC), the walk-in (WI-HTC) clinic at Kisesa Health Centre was more likely to attract higher risk individuals (those with larger numbers of sexual partners) and HIV-positive men and

women. However, because of the large numbers testing overall, the greatest numbers of HIV-positive individuals learned their status via CO-HTC (although we may have underestimated the overall numbers diagnosed at WI-HTC and ANC-HTC, due to low linkage sensitivity of the final matched clinic-cohort dataset, and the presence of reports of previous HTC use for which we did not know test results. The likelihood of underestimating HIV-diagnoses at WI-HTC or ANC-HTC was greatest at the Sero6 round, when 35% (185/520) of HIV-positive individuals reported previous HTC use for which we did not know HIV-status at the time of the test, although we were also unable to ascertain the location of possible diagnosis for 10% (53/514) of HIV-positive individuals at Sero5). This notwithstanding, CO-HTC is likely to have represented an efficient model of service delivery in which large numbers of people were reached in a short period of time, and several studies have reported that compared to facility-based services, community-based HTC approaches have been associated with substantial increases in the uptake of HIV testing by reducing logistical, financial and other barriers to service use (65, 66). Some studies have also found that compared to facility-based HTC, different types of outreach testing services, including mobile testing units, home-based testing, index testing (offering HTC to household members of people with HIV) and school or workplace-based testing programmes, have reached significantly larger proportions of first-time testers as well as HIV-positive individuals at early stages of infection (11). In this study, there were no substantial differences in HIV diagnoses by stage of infection by testing service type, but our analyses were limited by small sample sizes, particularly for users of WI-HTC and ANC-HTC.

In Kisesa and elsewhere in Tanzania, a holistic approach incorporating a variety of different service delivery options is likely to be most effective in increasing the overall uptake and coverage of testing. While there have been increases in the number of women tested via ANC-HTC over time (with the estimated proportions of female sero-survey participants first testing HIV-negative or being diagnosed HIV-positive at ANC-HTC increasing from 1.2% at Sero5 to 8.2% at Sero6), other PITC services were only introduced at the health centre's outpatients department in 2010, and to date very small proportions individuals have been tested here. Anecdotal evidence from conversations with staff at Kisesa Health Centre suggested that this related to a lack of time and training among clinicians working at the outpatients department. However, shortages of HIV test kit supplies were also highlighted as a critical issue, and it was reported that while clinicians were likely to refer patients

with symptoms suggestive of HIV to the WI-HTC, a routine offer of PITC was generally not made to asymptomatic patients at the outpatients department. (Denna Michael, personal communication August 2014). Furthermore, while in theory ANC-HTC is available to pregnant women attending the three rural dispensaries (located in the villages of Igekemaja, Welamasonga and Ihayabuyaga), other research in Kisesa has shown that the service is not always available due to shortages of staff or stock-outs of HIV test kits (141), and HTC services for the general population are not available at these clinics. There is a need for further expansion of HTC services within Kisesa, however a substantial investment of resources will be required, including investments in human resources and provision of HTC skills training for healthcare workers, ensuring a reliable supply-chain of HIV test kits, and developing robust systems for linkage of HIV-positive individuals to care and treatment services.

As the uptake of HTC services increases in Kisesa, there is a need to provide appropriate levels of supervision, training, monitoring and support for service providers. During qualitative interviews, HTC counsellors expressed a need for greater levels of mentoring and supervision as well as access to regular training sessions to update and renew their skills. Shortages of HIV-test kits were also highlighted as a particular challenge faced by counsellors, resulting in them having to turn away clients who wished to test, or having to make difficult ethical choices about who to test, both of which were an emotional burden and a considerable source of stress to counsellors. Although counsellors were generally viewed by clients in a positive light, during the qualitative study a few participants referred to rumours about breaches of confidentiality, and the counselling room at the ANC was considered insufficiently private. Other research in Kisesa has shown that pre-test counselling is not always provided as part of ANC-HTC, and that pregnant women were sometimes unaware of the right to decline testing (58). Ongoing training and support is required within HTC settings in Kisesa in order to ensure compliance with the 'five C's' of HTC (consent, confidentiality, counselling, correct test results, link to care) (189).

Linkage to care among individuals testing HIV-positive is an area of research that was beyond the scope of this PhD, yet is critical to understanding the relative success of different HTC services in contributing to universal access goals. Previous research in Africa has demonstrated poor rates of linkage between HTC and HIV

care services, with dropout at several stages along the pathway from diagnosis to care, including between diagnosis and measurement of CD4 count or clinical staging, between staging and assessment of ART eligibility, and between ART eligibility and treatment initiation (153, 190). In one systematic review, factors reported to facilitate completion of CD4 count measurements among individuals testing positive included the collection of blood samples at the time of diagnosis (to reduce the requirement for return appointments), the availability of point-of-care CD4 diagnostics, and workplace-based HTC programmes which had regular contact with clients (11). However, the data on linkage between HTC and HIV care services are sparse and further studies are needed in order to understand the relative success of different HTC strategies in facilitating linkage to care among HIV-positive individuals, such as investigating time to CD4 count measurement or ART eligibility assessment by HTC modality.

Socio-demographic differentials in HTC service use

In Kisesa, while smaller proportions of women than men had ever tested for HIV by the Sero4 round in 2003-2004 (8.8% versus 13.4%, respectively), over time coverage increased among women such that by Sero6 in 2010, larger proportions of women had ever tested compared to men (52% versus 41%, respectively). This was partially as a result of increases in the proportions of women using CO-HTC services over time, but also greater use of the WI-HTC at Kisesa Health Centre by women as compared to men, and the initiation of a routine offer of ANC-HTC to pregnant women from the end of 2008 onwards. Other studies in sub-Saharan Africa have noted that men represent an underserved group in terms of HTC coverage (41, 56), and that ways should be found to make services more accessible and acceptable to men, who may be disinclined to use health facilities more commonly frequented by women as a result of attendance at antenatal or maternal and child health clinic appointments. Men may also be restricted by work commitments in terms of the hours during which they can attend for testing, which calls for more flexible HTC service provision options such as late opening of clinics or options for home or workplace-based HTC.

Despite the fact that we found more women in Kisesa had ever tested compared to men, estimates of the proportions of HIV-positive individuals who had learned of

their positive status by Sero6 were lower among women (39%, 142/359) compared to men (46%, 75/161). Possible explanations for this include that we may have underestimated the proportions of women diagnosed via WI-HTC, which was used by more women than men, due to low linkage sensitivity between the WI-HTC and cohort dataset and the presence of reports of previous HTC use for which we did not know the test results. Other possible explanations include that increasing numbers of women have been tested via ANC-HTC over time, yet this service was not significantly more likely to attract HIV-positive compared to HIV-negative women in the logistic regression analyses presented in Chapter 4 (OR for ANC-HTC among women HIV positive <3 years since first positive research test compared to HIV-negative women: 0.74, 95% CI 0.12-4.56. OR for ANC-HTC among women HIV positive ≥3 years since first positive research test compared to HIV-negative women: 0.99, 95% CI 0.09-11.13). In addition, Chapter 5 showed that there was some evidence that CO-HTC services were significantly more likely to attract HIV-positive compared to HIV-negative men if they had never used HTC before, but the strength of this association among women was weak (OR at Sero6 for CO-HTC use among HIV-positive men who reported no prior HTC use compared to HIV-negative men: 1.62, 95% CI 0.99-2.64. Equivalent OR for women: 1.16, 95% CI 0.77-1.75).

Disparities in HTC service coverage by other socio-demographic characteristics persisted or increased in the study area over time. We found that men and women living in rural areas had significantly lower odds of using the CO-HTC service offered at Sero6, and similar findings were reported at earlier sero-survey rounds (42, 43). Similar associations between area of residence and uptake of testing were observed among users of WI-HTC (men only) and ANC-HTC. However, surprisingly, the measures of effect were greater for CO-HTC compared to the other service types, despite the fact that CO-HTC is offered locally within each village during sero-surveys, and so the distances required to access this service are smaller compared to WI-HTC and ANC-HTC (both of which are offered centrally at Kisesa Health Centre). Previous research has found high levels of HIV-related stigma in rural populations in sub-Saharan Africa (16, 191), and during the qualitative component of this research, participants highlighted concerns about being seen or recognised by a friend or neighbour at the WI-HTC clinic, as this was assumed to identify oneself as being at high-risk of HIV infection. During sero-surveys, it is possible that fears of being seen attending for HTC were greater in rural villages, due to higher levels of stigma and because clients were afraid of being recognised by friends or relatives

living within the same village. Greater distances to the health centre, in terms of access to the care and treatment centre (CTC), may also act as a deterrent to the uptake of HTC among residents of rural villages.

HTC services in Kisesa were disproportionately used by younger individuals, with men and women aged ≥ 55 being less likely to use CO-HTC and WI-HTC compared to those aged 15-24. The proportions using all types of HTC services were generally highest among those aged 25-44, although statistically significant associations were not always found in adjusted analyses. A higher level of education was an independent predictor of WI-HTC use among women, but not men. A similar finding was revealed for CO-HTC use among women, but the measure of effect was not as strong as for WI-HTC use, and level of education was not associated with uptake of ANC-HTC. In Kisesa and other similar settings, PITC and community-based HTC approaches are likely to increase the uptake of HTC by different socio-demographic groups by making a routine offer of testing to all individuals, thus eliminating some of the self-selection associated with traditional client-initiated VCT use.

Repeat testing

TasP approaches advocate regular repeat testing among high-risk HIV-negative individuals in order to facilitate diagnosis at early stages of infection (30, 82). In 2010, the WHO recommended at least annual testing of all HIV-negative individuals with sexual risk behaviours, regardless of epidemic setting (192). The analyses presented in Chapter 5 revealed that in Kisesa, rates of repeat testing were disappointingly low. By the Sero6 round in 2010, an estimated 16% (475/2,947) of HIV-negative men and 28% (45/161) of HIV-positive men had ever tested more than once (taking both known and reported HTC use into account, and with HIV-status reflecting that at Sero6 rather than at any earlier point in time). The corresponding figures for repeat testing among women were 22% (1,009/4,502) for HIV-negative individuals and 28% (102/359) for HIV-positive individuals. Other studies in Uganda and Malawi offering home-based HTC (83, 84) have shown higher rates of repeat testing compared to those seen in Kisesa. Furthermore, in one of these studies (84), there were no differences in the socio-demographic characteristics of those accepting and not accepting repeat HTC, demonstrating that home-based testing helped to reach an equitable distribution of service users by age-group and gender.

Among individuals who attended all three sero-survey rounds between 2003 and 2010 (n=2,010), just 11% of participants used the CO-HTC service twice or more, even when transport to the sero-survey site was provided free of charge, test-kits were adequately supplied and trust in counsellors was reported to be high (43). This demonstrates that the lower rates of repeat HTC seen in Kisesa compared to other sites are likely to be only partially explained by problems relating to the quality of service provision or HIV test kit supplies. Furthermore, at the later two sero-survey rounds in 2006-2007 and 2010, ART was available either in Mwanza town (with a transportation allowance for HIV-positive patients travelling to CTC sites there), or from the end of 2008 onwards, at the health centre within Kisesa itself. High levels of stigma and discrimination, and possibly the time and cost associated with potentially having to access the CTC at Kisesa Health Centre, may persist as significant barriers to the uptake of HTC in the study area.

The risk factor analyses presented in Chapters 4 and 5 revealed that although the numbers of individuals reporting previous HTC use were sometimes small (particularly at Sero4 and Sero5), when reported, this factor was strongly associated with testing again (for all service types). This suggests that modes of HTC service provision which reach large proportions of first time testers (such as CO-HTC in our setting) may confer considerable benefits in terms of encouraging subsequent HTC use. Adjusted analyses of risk factors for repeat testing among individuals attending both Sero5 and Sero6 found that men and women with higher risk sexual behaviours (those aged less than 15 at first sex, practising polygyny, or reporting inconsistent condom use) were more likely to have used the CO-HTC service at both rounds compared to those with lower risk behaviours. However, although individuals testing HIV-positive at Sero5 were less likely to use CO-HTC again at Sero6 than those who tested HIV-negative at Sero5 (aOR 0.17, 95% CI 0.06-0.52), sero-conversion between the two survey rounds was not associated with repeat CO-HTC use (OR 0.52, 95% CI 0.10-2.71). However, our sample size of sero-converters was small (just seven individuals) and so we were likely underpowered in testing this association. Overall, our findings provided some evidence for higher rates of repeat testing among high-risk HIV-negative individuals. Spousal HIV and HTC use status was also an independent predictor of repeat CO-HTC use (as well as of CO-HTC use overall and of ANC-HTC use, although not of WI-HTC use), suggesting that

couple counselling or the offer of partner testing could help to increase the uptake of HTC in Kisesa.

9.1.2 Impact of HTC on sexual risk behaviour

Increasing the overall uptake and coverage of HTC services in Kisesa may contribute to HIV-prevention by encouraging sexual risk reduction among individuals testing HIV-negative and HIV-positive. However, despite widespread assumptions in international policy documents that this is the case (4, 5), the systematic review presented in Chapter 2 revealed that quantitative evidence in support of this hypothesis is mixed, particularly among individuals testing HIV-negative. In Kisesa, quantitative and qualitative methods were used in order to explore the impact of HTC on sexual risk behaviours.

The quantitative analyses presented in Chapter 6 revealed moderate associations between CO-HTC use and reductions in some sexual risk behaviours among HIV-negative participants. For example, compared to those who had not used CO-HTC, HIV-negative men and women using CO-HTC at Sero4 or Sero5 were significantly more likely to report reductions in the number of sexual partners in the last year by the next sero-survey round (by Sero5: aOR 1.42, 95% CI 1.07-1.88, or by Sero6: aOR 1.68, 95% CI 1.25-2.26, respectively). Furthermore, there was no evidence for a lesser impact of HTC on reductions in the number of sexual partners (or on the observed association between CO-HTC use and loss of a non-cohabiting partner) at the later set of sero-survey rounds (between Sero5 in 2006-2007 and Sero6 in 2010) when ART was available within the study area (offered at Kisesa CTC from the end of 2008) compared to the earlier set of sero-survey rounds (between Sero4 in 2003-2004 and Sero5 in 2006-2007) when ART was only available in Mwanza city (from the start of 2005). These results are encouraging and do not provide evidence for sexual disinhibition associated with greater treatment availability, although further analyses should explore this topic using data from additional sero-survey rounds.

The qualitative research provided insights into possible reasons for some of the quantitative findings. For example, several barriers to sexual risk reduction with

primary partners were highlighted, including that condoms were rarely used. Accordingly, the quantitative analyses revealed few changes in condom use behaviour associated with CO-HTC use (except for an increased likelihood of stopping using condoms with regular non-cohabiting partners at last sex among HIV-negative individuals between Seros 4 and 5, aOR 4.88, 95% CI 1.39-17.16. Our interpretation of the meaning of this finding would be enhanced by knowledge of the HIV and HTC use status of partners). Furthermore, while HTC users tended to report positive attitudes and intentions regarding sexual risk reduction during IDIs, there were a number of barriers which appeared to limit behavioural change, including imbalanced client-counsellor interactions which limited communication during counselling sessions and the individual tailoring of counselling advice.

During the qualitative study, women reported that it was expected or accepted that men could have multiple partners, and women seemed unlikely to separate from primary partners upon whom they were economically dependent, even if infidelity was suspected. Women also reported difficulty talking to their partners about information or advice they had received during HTC. Previous qualitative research in north-western Tanzania and elsewhere in sub-Saharan Africa has reported the dominant role of men within relationships (183, 193, 194), and that women are often of lower status, linked to traditional systems of kinship and marriage (183). Such research has also highlighted that men's sexual respectability is often linked to greater sexual activity and the conquest of multiple partners (183, 193, 194), in contrast to women's sexual respectability which is characterised by obedience, faithfulness and subservience to male partners (183, 194). Similarly, in our qualitative study, women appeared limited in their capacity to be the instigators or initiators of behaviour change within their relationships. In quantitative analyses, we did not find evidence for a differing impact of CO-HTC on sexual risk behaviour by gender, however, we may have been limited in our ability to detect this by small sample sizes.

The WHO has recently recommended more widespread implementation of couples-based HTC (195), and some studies have found this mode of testing helped women to negotiate safer sex, and helped to strengthen communication and commitment to the relationship by both members of the couple (132, 134). However, a trial of the uptake and impact of couples-based versus individual VCT among ANC attendees

in Dar es Salaam found that only 33% (254/760) of women randomised to receive couples VCT at their next ANC appointment returned for testing with their partner, and of these, only 47% (119/254) agreed to counsel, test and receive their results together (196). In unadjusted analyses, women who completed couples VCT were significantly younger, of lower parity and were less likely to have ever experienced domestic violence compared to those who were randomised to couples VCT but did not complete it. Further research should explore the relative success of different HTC strategies in increasing the uptake of couples HTC, the factors which influence uptake, possible positive and negative outcomes of couples testing, and whether couples HTC helps to encourage greater reductions in sexual risk behaviour relative to individual HTC.

In quantitative analyses, we found no impact of CO-HTC on reductions in HIV incidence, or on reductions in sexual risk behaviour among individuals testing HIV-positive, but we were limited by small sample sizes as well as a declining background incidence in the study area over time (140). However, the systematic literature review presented in Chapter 2, as well as previous meta-analyses assessing the impact of HTC on sexual behaviour change and HIV incidence in developing countries (22, 23), found declines in sexual risk behaviour among individuals testing HIV-positive. In our qualitative study, HIV-positive individuals tended to report having reduced their levels of risk behaviour since diagnosis, in many cases because they had separated from their partners after diagnosis, or had chosen not to re-marry after a partner had died.

To date, five studies have investigated the impact of HTC interventions on HIV incidence in sub-Saharan Africa, including three cohort studies (83, 99, 101) and two RCTs (61, 97). The two RCTs found no overall impact of HTC on HIV incidence (although only one was powered to investigate incidence (97)). Of the three cohort studies, two reported no impact of HTC on HIV incidence (83, 99), while one found that the hazard of HIV acquisition was significantly lower among young people aged 15-24 in South Africa who reported previous HTC use compared to those reporting no prior HTC (0.59, 95% CI 0.45-0.78) (101). The differences in study findings may be partly due to study design, but Rosenberg et al hypothesize that HTC interventions may have a different impact among young people who are less likely to have formed behavioural habits, and are more likely to be in less stable non-

cohabiting partnerships, which may facilitate better adoption of HIV prevention counselling messages among this group. It is worth noting that one study exploring the impact of nine different types of behavioural interventions (including interventions other than HTC) on HIV incidence found that none of these RCTs showed statistically significant decreases (or increases) in HIV incidence. Three possible explanations were offered for this, including that the behavioural interventions were ineffective, that they were inadequately implemented, or there were problems with measuring effectiveness (197).

In Kisesa, the combined quantitative and qualitative evidence points towards a limited impact of HTC in terms of sexual risk reduction, likely due to a variety of socio-cultural and structural factors including sexual decision making and relationship dynamics, as well as limited client-counsellor interactions and an apparent lack of tailoring of individual risk reduction plans during counselling sessions. However, HTC services were highly valued by study participants, who mentioned that the service helped motivate them to try and avoid high risk behaviours. Of interest, one recent RCT in Uganda reported no significant differences in unprotected sex with partners of unknown or sero-discordant status associated with an abbreviated counselling session (based on PITC protocols – median duration of counselling was 16 minutes) when compared to standard VCT counselling (median duration of counselling 47 minutes), suggesting that briefer counselling sessions may be as effective as longer ones (198). In addition, in African settings, more culturally relevant counselling messages which acknowledge the importance of family and community in constructions of health and well-being may be more appropriate than Western models of counselling which tend to focus on individual agency and self-efficacy (29).

Ultimately, a combination of approaches to HIV prevention incorporating elements of biomedical, behavioural and structural interventions are likely to be most successful (197, 199). While the efficacy of different biomedical HIV-prevention strategies has been proven in the context of clinical trials (31, 200, 201), many challenges to their implementation exist, and behavioural interventions are important in their own right, as they may contribute to background levels of HIV-related knowledge and influence general population attitudes regarding safe sexual behaviour, as well as adherence to biomedical interventions (197).

9.2 Strengths and limitations of the research

9.2.1 Strengths

One of the main strengths of the research presented in this thesis relates to its context within a long-term demographic and HIV surveillance site, providing a wealth of data on demographic, clinical and behavioural factors, as well as on HTC use, since 2003. There have been considerable changes in the provision of HIV services in the study area during this period, with increasing availability of HTC during sero-survey rounds since 2003, the opening of the WI-HTC clinic at Kisesa Health Centre in 2005, and the routine offer of HTC to pregnant women at the ANC from the end of 2008 onwards. The Tanzanian national ART programme was rolled out at the start of 2005, with free treatment initially available at CTC sites in Mwanza city, and since the end of 2008 at a local CTC within the study area. These changes allowed for an assessment of the effect of increasing availability of different types of HIV services on the uptake of testing, as well as an investigation of the impact of HTC on changes in sexual risk behaviour before and after greater availability of ART in the study area.

The linkage of data from demographic surveys, sero-surveillance rounds and HTC services allowed for the investigation of a range of risk factors for HTC service use, including duration of HIV infection, due to the availability of information on HIV-status among both users and non-users of HTC services at the community level. Furthermore, the linkage of the health centre HTC clinic dataset to the Kisesa research datasets allowed for a comparison of risk factors for service use by HTC delivery model. The impact of CO-HTC services on sexual risk behaviours could be explored over extended periods of follow-up (two to three years, for subsets of individuals attending more than one sero-survey round), while the cohort and demographic surveillance datasets provided a useful sampling frame from which users and non-users of HTC services could be recruited for the qualitative study.

The HTC services provided in Kisesa and assessed in the analyses presented in this thesis are likely to be typical of the types of services that are, or could be, provided in similar rural settings, making the research findings generalizable and of importance to policy makers more widely in Tanzania as they look for ways to scale

up provision of HTC and related HIV services. Although part of a research study, the CO-HTC services offered during sero-surveys provide an example of one model or option for delivery of community-based HTC, with the counselling and testing procedures implemented according to Tanzanian national guidelines (6). The testing services offered at the WI-HTC and the ANC at Kisesa Health Centre are also expected to be characteristic of services offered at similar clinics in other rural settings in Tanzania, as they were part of the routinely-provided district-level health services. Due to the observational nature of the study design, recommended improvements to service provision can be fed back directly to health officials at regional, district and ward levels (see Dissemination in section 9.5).

A further strength of this study relates to the use of mixed methods, drawing on both quantitative and qualitative approaches in order to increase the depth of the research findings. The qualitative component used a variety of data collection methods, including PLA activities and IDIs in order to maximise learning from different perspectives, and provided possible elucidations for the modest reductions in sexual risk behaviours observed among HIV-negative individuals in the quantitative analyses. This included an understanding of the socio-cultural and structural factors which shaped sexual behaviour following HTC, and the importance of the local context in understanding responses to HIV prevention counselling messages. Although it was expected that the qualitative study would contribute mainly to understanding perceptions of the content of HTC sessions, during PLAs and IDIs participants highlighted issues which were useful in understanding barriers to service access such as fears of HIV-related stigma, and issues relating to service provision, such as the availability of HIV test-kit supplies.

In terms of the quantitative analyses, few sites in sub-Saharan Africa have made use of data linkage procedures to match routinely collected data from health facilities to research study datasets. The linkage methods used to match users of the WI-HTC and ANC-HTC services to the cohort dataset used novel techniques and provided methodological contributions, which will be of use to other sites attempting to develop procedures for retrospective or prospective data linkage. The methodology developed serves as a starting point for future research in Kisesa using existing or new linked HTC clinic-cohort datasets. The output of the analyses

using the linked datasets provided new insight into the relative success of different HTC services in increasing the overall uptake and coverage of HTC in Kisesa.

9.2.2 Limitations

One of the main limitations of the research relates to the observational nature of the study design and the potential for participation bias, which may have led to over or under estimation of some of the effects investigated (202) – for example if subsets of sero-survey participants (e.g. those with at least a primary level of education) were more or less likely to use HTC services than similar individuals who did not participate. We have seen declining participation in sero-surveys over time, from approximately 85% in Sero1 in 1994-1995 to approximately 55% in Sero6 in 2010, and so the potential effects of participation bias are likely to have grown over time. There have been larger decreases in participation among certain sub-groups – namely men aged between 25 and 44, likely as a result of migration for work. Previous research has shown that migration is associated with a higher risk of HIV infection (203), and so this may have resulted in overestimates, or perhaps more likely underestimates, of the strength of the associations between HIV-status and/or sexual risk behaviours (numbers of sexual partners, condom use, etc) and CO-HTC or WI-HTC use among men. Previous research has also shown that HIV-positive individuals are less likely to participate in population-based sero-surveillance because they may fear others learning their HIV status, and/or as increasing numbers of individuals test and thus are already aware of their status (163, 204, 205). This may have led to particular effects among HIV-positives – for example if sero-surveys tended to attract positive individuals with relatively higher (or lower) risk behaviours compared to positive individuals who did not participate. Despite the possible participation biases, the crude analyses presented in Chapter 5 showed a similar range of factors to be associated with CO-HTC use at the three sero-survey rounds between 2003 and 2010, and many of the risk factors for HTC use in this study (e.g. area of residence, level of education, higher risk sexual behaviours) have also been reported in other similar settings in sub-Saharan Africa (40, 80, 81).

There are inherent difficulties in measuring self-reported sexual behaviour, which may be subject to recall and social desirability biases (164, 169, 173, 179). Within the Kisesa cohort study, the questions on sexual behaviour are reviewed and updated for each round of the study, in order to try and maximise the quality of the

data collected (for example 'partner loops' were introduced during Sero6 so that questions on partners and sexual behaviour were clearer and happened in chronological order). While it is difficult to remove all potential for recall and/or social desirability bias from questioning on sexual behaviour, it is worth noting that comparative analyses of data from Kisesa and other cohort sites have found that while poor recall or inaccuracies in reporting of some behaviours (e.g. age at first sex, age at first marriage) introduced noise, they did not bias results in a systematic way (206, 207). In the quantitative analyses presented in Paper C, it is possible that recall error may have biased some of our risk ratios towards one, if such noise or random error was present. On the other hand, social desirability biases may have overstated the associations between CO-HTC use and changes in sexual risk behaviour, if those who used the service were more likely to report reductions in risky behaviour compared to those who did not. During qualitative data collection, participants tended to report compliance with 'instructions' regarding safe sexual behaviour which were received from counsellors, providing some evidence that social desirability biases were present. Some population-based studies have used informal confidential voting methods to collect sexual behaviour data (208), and such strategies may be useful for consideration in future rounds of the Kisesa cohort study.

In quantitative analyses, sample sizes were sometimes small (particularly for the analyses assessing risk factors for ANC-HTC use, and the impact of CO-HTC on sexual risk behaviours among HIV-positive individuals), which may have limited my ability to detect smaller effects for some exposures. Residual confounding by unmeasured variables may also have occurred. In particular, for the analyses of the impact of CO-HTC on sexual behaviour change, it would have been helpful to have accounted for the HIV and HTC use status of partners, and further analyses among the subset of married and co-habiting couples for whom this information is available are warranted. In addition, data were not available on whether clients were counselled as individuals or couples during CO-HTC, and this information would be useful in order to allow future analyses of the potential impacts of this mode of service delivery on sexual risk reduction.

While the linkage of the data on WI-HTC and ANC-HTC use at the health centre to the community cohort dataset was a novel contribution and harnessed the power of

the data available from the research dataset, it is worth mentioning that methods for retrospective data linkage are still in development and a number of issues were encountered during the linkage process which limited the positive predictive value (PPV) (i.e. of the gold standard records matched, the proportion which were correctly matched) and sensitivity (i.e. the overall proportion of gold standard links which were correctly matched) of the final linked clinic-cohort dataset. Firstly, the linkage algorithm was ultimately a trade-off between sensitivity and specificity, and we obtained large numbers of potential multiple matches for each HTC clinic record. Various validation procedures were applied in an attempt to choose a single best cohort match for each clinic record. Ultimately, the result of this process was a reasonable PPV (69%), which could be further increased to 78% and 85% by placing additional restrictions on final matched-pairs accepted, at the expense of further losses in sensitivity. Analyses run using the higher PPV datasets did not change overall findings, giving confidence in the results obtained using the largest, lowest PPV dataset.

Of relatively greater concern was the low estimated sensitivity of the final linked dataset, at just 18%. Although a high linkage rate was initially achieved (94% of 10,994 Kisesa resident users of the WI-HTC clinic between 2005 and 2012 initially matched to the cohort dataset), large proportions of clinic records were dropped during the final two validation procedures. This included 32% (3,337/10,289) of the initially matched records dropped due to selection of a single best match-pair where an identical cohort record had been matched to more than one clinic ID number (these match-pairs may have represented either one or more than one person, but the extent of this was unknown, due to unreliable systems for linking repeat visits together under one ID number at the WI-HTC clinic), and 28% (2,881/10,289) of the initially matched records dropped after manual selection of a score threshold, below which the accuracy of match-pairs was in doubt.

In comparative analyses, HTC clinic attendees for whom a single best match could be found in the cohort dataset were more likely to be female ($p<0.001$), more likely to be older ($p<0.001$) and less likely to have secondary education ($p=0.002$) than those not included (either because they had not been linked in the first place, or more commonly because their record had been dropped during validation procedures), and this may have led to biases in our assessment of some of the risk

factors associated with WI-HTC and ANC-HTC use. For example, we may have underestimated the proportions of men using WI-HTC, or we may have underestimated the strength of associations between age and/or educational attainment and WI-HTC or ANC-HTC use. However, reassuringly, there were no significant differences in the proportions of individuals included in final analyses by HIV-status ($p=0.9$). Records for the final year for which WI-HTC clinic data were available (2012) were incomplete, and this may have led to misclassification of the outcome (WI-HTC or ANC-HTC use) for a small proportion of individuals, which would have biased odds ratios towards one. Despite the limitations of the linkage procedures and the low sensitivity achieved, the identified risk factors for WI-HTC and ANC-HTC use were not wholly unexpected (e.g. residents in urban areas more likely to use WI-HTC (men only) and ANC-HTC compared to those living in rural villages, level of education associated with WI-HTC use (women only)), and are broadly in line with other studies assessing the uptake of these types of services in sub-Saharan Africa (76, 78, 79). Future analyses should build on the record linkage methodology developed as part of this thesis, taking advantage of potentially larger, improved datasets (in terms of PPV and sensitivity) which may be outputted (see Section 9.4 on recommendations for future research below).

During the qualitative component of the research, local facilitators were used in order to overcome language barriers as well as to help generate richer, less biased data. However, had I been able to conduct the group activities and interviews myself I might have gained a deeper insight into the data, some of which may have been partially lost during the processes of transcription and translation. Due to limited availability of staff, transcription and translation of audio-recordings did not begin until data collection was complete. Ideally transcription and translation would have happened as the study progressed, in order to explore emerging themes and make amendments to the data collection tools as the study proceeded, although modifications to the content of the IDI guidelines were made based on debriefing sessions held with research assistants after each interview. In retrospect it appears as though the sampling frame used to recruit HTC users included too few women who had completed ANC-HTC (only three were interviewed), and it would have been interesting to have collected a broader range of views from women who had used this service. The ability of the research assistants to elicit information from HTC users may have been limited by the sensitive nature of the topic, a possible hierarchical relationship between participants and research assistants, and/or by

social desirability biases, all of which may have inhibited participants from disclosing or discussing high-risk sexual behaviours with researchers.

9.3 Reflections on the research

9.3.1 The research setting

The Kisesa cohort study is an observational study which does not include HIV education or prevention interventions other than those, such as the provision of HTC services, which are already part of district level HIV prevention programming. Other HIV prevention activities carried out within study area (e.g. school or community-based HIV education and prevention campaigns, occasional outreach HIV testing campaigns) are part of standard HIV prevention efforts coordinated by the District AIDS Committee and the Ministry of Health and Social Welfare. As an observational research site with minimal additional interventions, the results from the Kisesa cohort study are thus generalisable to other similar rural settings elsewhere in Tanzania and sub-Saharan Africa. Nevertheless, it is worth considering how participation in the research itself (i.e. the rounds of demographic and serological surveillance, and any associated research activities such as qualitative studies) may have influenced the results obtained.

During the informed consent process, sero-survey participants are provided with information on HIV, and are free to ask any questions they may have, which may lead to improvements in their levels of HIV-related knowledge and awareness. The process of answering the sero-survey questions may also add to participants' HIV-related knowledge, and sero-surveys extend the reach and availability of HTC services via the temporary CO-HTC clinics which are set-up within each village, constituting an additional source of information on HIV. Residents within the study area are also invited to periodic community meetings where the results of the research are disseminated. As such, and as a result of the extended period of time over which sero-surveys have been conducted (since 1994), it is likely that Kisesa cohort study participants have better HIV-related knowledge compared to other similar but less studied rural populations elsewhere in Mwanza region or in Tanzania. This may have led to higher rates of uptake of HTC, or better responses to HIV-prevention counselling messages, than might be expected in other settings. However, despite this, the proportions of sero-survey participants using CO-HTC

were low (as shown in Paper B), as were the proportions of individuals using other HTC services in the study area (as shown in Paper A). This suggests that cohort study participation did not increase HTC uptake as much as one might have expected.

The quantitative and qualitative analyses presented in Papers C and D provided only moderate evidence for an association between HTC use and changes in sexual risk behaviour. As such, it seems unlikely that the additional HIV-related knowledge or awareness imparted as a result of participation in the cohort study led to significantly greater reductions in sexual risk behaviour than might have otherwise been seen. This is supported by findings from the qualitative research, which highlighted various socio-cultural barriers which inhibited sexual behaviour change following HTC use, regardless of individual level factors such feelings of self-efficacy or levels of HIV-related knowledge.

Although it increased over time, the uptake of CO-HTC offered during sero-surveys in Kisesa was low, being just 25% at the Sero6 round in 2010 (despite the fact that a routine offer of CO-HTC was made to all study participants, and that ART has been freely available at Kisesa health centre since late 2008). The uptake of CO-HTC in Kisesa is considerably lower than that reported in a recent meta-analysis of community based HTC approaches, which reported that in 14 studies (10 of which were conducted in sub-Saharan Africa), overall 87% of participants accepted to use mobile community-based outreach HTC services when they were offered (11). Differences in the uptake of community-outreach HTC between settings may relate to the way in which services are provided, for example whether services are provided independently, alongside community mobilisation activities, or as part of a research study. In Kisesa, although all study participants may use CO-HTC without participating in the sero-survey (i.e. without completing the sero-survey questionnaire or providing a blood sample), in practice the proportion of individuals who do this is small (<5%). According to study protocol, CO-HTC is completed as the last step or stage in study participation (i.e. after completion of the questionnaire (for those who choose to complete it), provision of a finger prick blood sample and medical consultation with a study clinician (if desired)). As such, sero-survey participation may be incorrectly perceived as a requirement or pre-requisite for CO-HTC use, or study participants may be disinclined to use CO-HTC after they have

already spent a reasonably lengthy period of time completing the sero-survey questionnaire (approximately 45 minutes to one hour) and participating in other elements of the study. The CO-HTC services offered during sero-surveys are provided by trained counsellors who come from outside the study area. However, some of the counsellors providing HTC during sero-surveys also work at Kisesa health centre, and it is possible that fears of being seen or recognised by these healthcare workers may make participants disinclined to use the CO-HTC services offered during sero-surveys.

The aspects of sero-survey participation described above may have had a negative impact on the uptake of CO-HTC in Kisesa, which might have been higher if the service had been offered independently of the sero-survey. However, it is worth noting that levels of HIV-related stigma and discrimination are high in Kisesa (16, 162), and this is also likely to have influenced the low uptake of HTC seen. Additional factors which may have contributed to low HTC uptake include perceived or actual barriers to accessing ART in the case of a positive diagnosis, particularly for those living in the rural villages located furthest from the trading centre.

9.3.2 Looking back: lessons learned

Inevitably a PhD is a learning process and a journey of accomplishments and triumphs, as well as of setbacks and moments of uncertainty or difficulty. At the point of completion, it is worth reflecting on the work undertaken and taking stock of the lessons learned, in order that these might inform and improve future research. Some of these lessons and learnings are summarised below.

The probabilistic record linkage work undertaken to match data from the health centre HTC clinic to the cohort dataset was perhaps the most challenging technical task undertaken as part of my PhD, and involved collaboration with IT experts based at NIMR Mwanza. I was thankful to work alongside these data managers during one of my periods of fieldwork in Tanzania between January and April 2012. This time provided us with an invaluable opportunity to develop the record linkage algorithm, working on several different versions of the model, and continually reviewing and refining it in order to improve the output. Validation of the final linked dataset that I

obtained occurred after I had returned to the UK. At this point it became clear that documentation of the steps we had undertaken during development of the linkage algorithm was not always clear or detailed enough, and these details were much more difficult to ascertain at a later point in time. Future research teams should ensure that all methods are recorded in detail at each stage of model development, and that these are reviewed by all team members in a timely manner in order to ensure their accuracy and to reach consensus where there is uncertainty. This will help to improve the utility of the outputted datasets and to resolve queries regarding optimal approaches to data analysis.

Inevitably we learned other lessons during development of the probabilistic record linkage algorithm and if doing the work again, we might approach some aspects a bit differently. We trained and tested our record linkage algorithm using the same gold standard dataset (i.e. we developed the scoring scheme, and then assessed the performance of the model (in terms of its sensitivity and positive predictive value), using the same dataset), because this was the only gold standard dataset available to us at the time. Future attempts at probabilistic record linkage would benefit from using different gold standards for each of these two steps, as this would provide a more robust test of the model's performance. We also encountered difficulties due to the fact that re-visits by the same client at the HTC clinic are often given a new client ID number. Thus, whenever the same cohort record had been selected as the best match for more than one clinic ID, it was not known whether these matches were all correct (because the different clinic ID numbers represented the same individual), or whether one or more of the matches were false (because the different clinic ID numbers represented different individuals). An alternative approach would have been to match the HTC clinic dataset onto itself first (in order to identify unique clients) before linking to the cohort dataset. Ultimately this might have improved the sensitivity of the final linked dataset we obtained. Further suggestions for refining the probabilistic record linkage algorithm and for future research on this topic are presented in Section 9.5.4 below.

The qualitative study that I designed and conducted in Kisesa was also a challenging yet rewarding part of my PhD research. It presented me with a steep learning curve during which I had to familiarise myself with the theory underlying approaches to qualitative data collection and analysis. I was required to design my

data collection tools, draw up a sampling frame from the cohort study datasets, help with training the research assistants, coordinate the logistics of recruitment and data collection, and finally collect and analyse the data. As my first experience designing and conducting a qualitative study, there are in retrospect some things I might have done differently. For example, the research assistants had only limited prior experience conducting PLA activities, and this was an element of the study which they found particularly challenging. In order to reduce the length and complexity of the group sessions, the number of PLA activities was reduced from two to one. Alternative options which might have allowed us to get richer data from the group sessions would have been to spend some additional time on training, and/or to have carried out the sessions over two days in order allow the additional PLA activity to be conducted.

The qualitative study went more or less according to schedule, but one of the group activities (among men from urban villages) had to be repeated due to poor attendance and participation in the first activity. This highlights the importance of being flexible and allowing for extra time or changes to the study schedule when needed. I used a combination of purposive and snowball sampling techniques to recruit participants for the group activities. I achieved a good response rate (40/48 purposively sampled men and women attended the group activities, 32 of whom brought a friend or neighbour to participate). However I might have achieved an even better response rate if I had purposively sampled all individuals, which would not have been difficult to do, and would have given me access to demographic and other information (such as HIV status) on all group activity participants, not just the 40 who were purposively sampled.

As a private and intimate topic, talking about sexual behaviour is likely to be uncomfortable or difficult for many study participants. During IDIs, the development of trust and rapport between researcher and research participant is thus particularly important. It is possible that additional IDIs with each individual, spaced perhaps a few weeks apart, might have helped participants to develop better rapport with researcher assistants, and thus to discuss the nature of their sexual partnerships, as well as of their relationships with counsellors, in greater detail. This might have helped to generate richer data than could be obtained from a single IDI on a sensitive topic.

Papers B and C (Chapters 4 and 5) were the first papers which I wrote up and submitted for publication as part of my PhD. From a personal point of view, I found this process extremely helpful as it gave me an opportunity to learn how to distil and present the most important findings from my analyses, to develop my writing skills, and to gain useful and insightful feedback from co-authors and reviewers. Inevitably the analyses presented in each of these papers went through a number of iterations before arriving at the final product, which perhaps lengthened the amount of time it took to complete them. Nevertheless, I found the process a rewarding and invaluable learning experience.

9.4 Programme and policy recommendations

This section highlights the programme and policy recommendations arising out of the research, which will be relevant to policy makers in Kisesa and other similar rural settings in Tanzania.

9.4.1 Promoting access to HTC services

Although there was limited evidence for an impact of HTC on reductions in sexual risk behaviour, improvements to service provision may improve their effectiveness, and HTC services have a role to play in the biomedical prevention of HIV, as well as in improving background levels of HIV-related knowledge within the community. Although they have increased over time, the rates of uptake of HTC in Kisesa remain low, and additional strategies should be employed in order to encourage further increases in the uptake of testing services, such as the provision of additional community-based HTC services. This would likely require considerable investment in terms of finance and human resources, although community outreach HTC services have proven to be cost-effective relative to traditional client-initiated VCT services in other settings (64, 67). Successful strategies for implementation might require collaboration or partnerships with governmental or non-governmental organisations (NGOs) or community groups already offering HIV-related services in the study area.

Alongside efforts to scale-up HTC service provision, structural and community level programmes must be employed in order to tackle HIV-related stigma and discrimination, which was highlighted as a barrier to accessing HTC services in the qualitative research. These might include social and community mobilisation programmes which aim to catalyse social change, or more formal structural interventions such as improved education (which was significantly associated with HTC use), and permissive legal and policy frameworks which do not discriminate against HIV-positive individuals. Where national level policy change is difficult to achieve, local leaders and community groups such as village elders, village AIDS committees, healthcare workers and NGOs can lobby for local action and change. The potential impacts of such interventions are likely to take a lengthy period of time before being seen and their effectiveness may be difficult to measure, however they represent public goods in their own right.

The qualitative research indicated that awareness of the availability of HTC services in the study area was high, nevertheless there was sometimes confusion relating to issues to do with service provision, for example the frequency with which CO-HTC services were offered. HTC counsellors could help to promote the uptake of HTC services via attendance at community meetings, during which they could provide clarifications and further information. HTC counsellors could also ensure different healthcare providers have relevant information about the provision and availability of HTC services, encouraging them to provide information about testing to their patients. Clients who have undergone HTC and are willing to provide information on the relative advantages of testing could act as peer educators within their communities in order to encourage others to consider testing (and at least one individual participating in IDIs mentioned that he was interested in taking on such a role).

9.4.2 Strengthening HTC service provision at Kisesa Health Centre

A significant barrier to HTC service provision at Kisesa Health Centre related to shortages of HIV test-kit supplies. It was unclear whether this related to systems for procurement at the medical stores departments at district or national levels, or whether it may have related to problems with procedures for estimating and reporting supply requirements at the WI-HTC and ANC. Robust systems should be put in place in order to ensure a reliable supply of HIV test kits, thereby avoiding

missed opportunities for testing, maintaining community trust and confidence in healthcare systems, and avoiding undue stress to healthcare workers. Other potential structural improvements at the health centre include the provision of dedicated rooms for private counselling of pregnant women, who received their post-test counselling in an only partially private area. Although conducted in enclosed rooms, clients at the WI-HTC also expressed concerns that their counselling sessions might be overheard by staff in a doctor's clinic located close to the WI-HTC building, and measures should be taken to ensure that all HTC sessions take place in an environment that is private and confidential.

Strategies for PITC were not fully implemented at Kisesa Health Centre, particularly at the outpatients department. Additional training on issues relating to HTC and HIV care, as well as additional human resource capacity and systems for referral of HIV-positive individuals to the CTC, will be required in order to enable healthcare workers at the outpatient clinics to routinely offer these services. During qualitative interviews, one woman mentioned that she received very little pre or post-test counselling during antenatal PITC, and other research in Kisesa has shown that pre-test counselling is not always provided to pregnant women, undermining their ability to opt out of testing and resulting in missed opportunities for counselling (58). Women at the ANC are sometimes referred for testing at the WI-HTC, dependant on staff capacity and the availability of HIV test kits at the ANC. This sometimes resulted in duplication of work-load in terms of record keeping and reporting; as women were first logged in a test-book at the ANC (in order to report on testing of pregnant women), and then logged again in another test-book at the WI-HTC (in order report on all testing carried out at the WI-HTC). Systems for gathering and reporting data on testing carried out at the various clinics at the health centre should be streamlined in order to avoid such duplication.

Improved systems for the collection and management of data on HTC carried out at the ANC, WI-HTC and outpatient clinics would improve the utility of these data. A standardised TAZAMA logbook should be designed for entry of HIV test results at the WI-HTC clinic, in order to improve the linkage between main logbook and test results data. Computerised data entry of HTC logbooks may be problematic due to frequent power-cuts, however such systems are already in place at the CTC, and would be beneficial in terms of improving the quality and reporting of data. For

example, client ID numbers could be automatically generated, drop down menus would help to standardise data entry, and a search function might help counsellors to trace returning clients and record their unique identifier against each visit, providing better information on repeat testing. Such systems would also assist with reporting on numbers of clients seen and tests completed to District AIDS Committees and the medical stores department, as well as with future projects to retrospectively or prospectively link data on HTC use at the health centre to the Kisesa cohort datasets.

9.4.3 Decentralisation of services and improving HTC service provision in rural areas

Residents of rural villages in Kisesa remain underserved in terms of their access to HTC services. Community level programmes should aim to tackle HIV-related stigma and discrimination, and to provide information on the benefits of testing to residents of rural communities. There are three dispensaries located in rural areas of Kisesa. These provide basic outpatient and maternal and child health services, and since mid-2009 antenatal PITC is usually offered to pregnant women, however this is dependent on staffing and the availability of HIV test-kit supplies. Furthermore, HTC services for the general population are not available. Systems for HTC service provision at the rural dispensaries should be strengthened in order to improve PITC services and make HTC available to the general population. This will likely require investments in training for healthcare workers as well as in additional human resources and structural capacity (i.e. availability of suitable counselling rooms), improved procedures for procurement of HIV test kits, and robust systems for referral of HIV-positive patients to treatment and care.

HIV care and treatment services are available centrally within Kisesa at the health centre, or further away in Mwanza city for those requiring referral for example because of treatment failure. Nevertheless, the distance and cost associated with potentially having to travel to the health centre in the case of an HIV-positive diagnosis may represent a significant deterrent to testing among those living in rural villages. The infrastructural and resource requirements associated with further decentralisation of HIV treatment to rural villages may be too significant to enable such an expansion of services, however alternative options should be explored such

as weekly subsidised transport to the health centre, microfinance initiatives which encourage community development, and/or community bicycle or motorbike renting or sharing schemes which might assist rural villagers in accessing the trading centre.

9.4.4 Enhancements to counselling

The qualitative research highlighted potential limitations to the types of advice and information included as part of HIV-prevention counselling messages, which tended to focus on 'ABC' (abstain, be faithful, use condoms) messages regardless of the fact that abstinence seemed an unrealistic and unlikely option for most participants, and condom use was low. Counselling approaches which focus on positive outcomes, for example by highlighting opportunities for protecting unborn children from HIV, and which incorporate constructs relating to family and community into counselling messages, may be more effective than those which focus on individualistic and negative perceptions of disease and risk (29, 115, 209). As such, a review of the theory and protocols underpinning counsellor training may be warranted.

The qualitative research also highlighted limited interactions between clients and counsellors during HTC sessions, with clients stating their intentions to comply with dictated 'instructions' received from counsellors, and little evidence that intimate thoughts or behaviours were shared by clients. This may relate partly to the sensitive nature of the topic, but also to levels of trust in counsellors and/or the hierarchical nature of the relationship between healthcare providers and clients. Although existing VCT guidelines encourage the development of individualised and actionable risk reduction plans (6), there was little evidence of this occurring. More frequent and in-depth counsellor training sessions may help to address some of these issues, particularly including modules focussing on methods for engendering more engaged and equitable discussions between clients and counsellors, and for enabling freer conversations around intimate and private sexual topics.

9.4.5 Promotion of couples testing

In Kisesa, the data indicate that a very small proportion of HTC users are counselled as couples (based on testing at the health centre; information on couples-testing not currently available from the sero-survey data), and this is in line with trends elsewhere in sub-Saharan Africa where HTC programmes have tended to focus on individuals (210). However, the WHO have recently recommended greater implementation of couples-HTC (195), and this approach has been associated with greater rates of HIV sero-status disclosure, reduced levels of risk behaviour (particularly among sero-discordant couples – (106-108)), and greater rates of uptake of ART and PMTCT services (110, 196, 210, 211).

The quantitative analyses revealed that partner HTC use was positively associated with HTC uptake among married men and women, demonstrating that there may be unmet potential to increase the overall uptake of testing by providing support for partner testing or testing of couples in Kisesa. Because the rates of ever testing are currently higher among females compared to males, couples testing also holds the potential to reach larger numbers of men by implementing strategies which encourage women to attend or return for testing with their partner. Such strategies might include priority for couples attending HTC clinics together, more permissive opening hours (e.g. afternoon or evening hours) which may allow more men to attend for testing, or certain days or times which are reserved specifically for couples. Counsellors providing couples-HTC are likely to require additional levels of training and support on specific topics such as those relating to mediating sero-status disclosure (particularly where the couple is sero-discordant), and providing explanations for sero-discordance, which has previously proven to be challenging in some African settings (181, 212).

9.5 Recommendations for future research

9.5.1 Monitoring access to HTC services

As the uptake of HTC services increases over time, data from Sero7 (not used in this thesis), as well as additional future sero-surveys and data from the HTC services at Kisesa Health Centre should be used to monitor trends in access, for example whether community mobilisation activities help in increasing uptake among relatively underserved groups, such as those living in rural areas, or whether

additional PITC services (for example at sexually transmitted infections or tuberculosis clinics) help in reaching more men. If additional HTC strategies (such as home-based testing) are implemented in Kisesa, opportunities should be explored to forge collaborations between these projects and TAZAMA, with a view to anonymously linking these data to the Kisesa cohort, enabling quantitative analyses of service use similar to those presented in this thesis to be conducted. The analyses conducted among pregnant women undergoing ANC-HTC only included women who had received this service after referral to the WI-HTC. Future work should build on these analyses by making use of data on testing of pregnant women which occurred within the ANC building itself, and also data on testing of pregnant women at the rural dispensaries (some of which have already been linked to the Kisesa cohort as part of a separate project (141)).

While rates of repeat testing were explored as part of this thesis, future research should investigate trends over time and make additional use of data from Kisesa Health Centre as data collection and record linkage procedures are optimised, making it easier to identify repeat testers within the health centre datasets. The ability to investigate the association between HIV sero-conversion and repeat use of HTC was limited by a small sample size. Future analyses should explore this association making use of additional rounds of sero-surveillance data, pooling data across rounds if necessary. Future qualitative research might explore opinions regarding repeat testing, reasons for doing so and/or preferences for HTC service types, as well as perceived negative and positive outcomes of undergoing HTC.

Future research could also assess the relative cost effectiveness of different HTC strategies in Kisesa, gathering data on costs of service provision, and reporting on costs per client tested and per HIV-positive individual diagnosed. Similar studies elsewhere in sub-Saharan Africa have reported that community-outreach HTC models are cost effective in comparison to facility-based services (64, 67), but a better understanding of this in the Kisesa context would be useful to Tanzanian policy makers as they allocate future funds for HIV treatment and prevention programmes.

9.5.2 Investigating linkage to care by HTC service type

Of paramount importance in terms of universal access to HIV care and treatment and potential TasP approaches will be an understanding of the relative success of different HTC strategies in linking HIV-positive individuals to treatment clinics, yet few data on this topic are available, and recording systems are often not kept up to date for HIV-positive individuals who have registered in care but are not yet eligible for ART (153). The Kisesa cohort study is well suited to investigate this topic, due to the existence of a referral system which tracks individuals from the point of testing during sero-surveys or at the WI-HTC through to registration at the health centre's CTC or at Bugando Medical Centre CTC in Mwanza city, using custom designed referral forms. Referrals of pregnant women testing HIV-positive at the ANC are also made using national PMTCT transfer forms. Future analyses should explore overall rates of referral uptake by HTC modality, as well as time to CD4 count measurement or ART eligibility assessment. Risk factor analyses should be conducted in order to identify factors associated with successful referral and to help devise strategies to improve referral uptake, while comparative analyses could also explore the relative success of referral by CTC location (Kisesa Health Centre or Mwanza CTC sites). One study in Uganda reported that an enhanced linkage intervention (including counselling about barriers to care, a scheduled appointment at the treatment clinic, and reminders by mobile phone or home visits) reduced time to enrolment in HIV-care compared to 'standard' referrals (198), and the potential benefits of such approaches could also be explored in Kisesa. Qualitative research should explore barriers and enabling factors to registration in care among HIV-positive individuals, with a particular focus on the relative ease or difficulty of referral uptake by testing service type.

Other potential areas for future research in Kisesa or elsewhere include the linkage of HIV-negative individuals to further HIV-prevention services, such as referral of HIV-negative men to programmes for medical male circumcision, or referral of high-risk HIV-negative women to pre-exposure prophylaxis programmes, if these services become more widely available in the future.

9.5.3 Further analyses of the impact of HTC on sexual behaviour change

The quantitative analyses presented in this thesis explored the impact of CO-HTC services offered during sero-surveys on reductions in reported sexual risk behaviours. Further analyses should build on this work by making comparisons between HTC service types, making use of the linked health centre-cohort dataset, which was still under development at the time the sexual behaviour changes analyses were completed. This would allow an assessment of the relative success of different modes of HTC service delivery in producing reductions in risky sexual behaviours. Further analyses should also be conducted among the subset of married and co-habiting couples for whom HIV and HTC use status are available, as this would provide more detailed information on levels of risk (for example by providing information on partner HIV-status), and might help in explaining some of the changes seen (for example potential reductions in condom use if both members of a couple had undergone HTC and tested HIV-negative).

The investigation of the impact of CO-HTC on sexual behaviour change among HIV-positive individuals was limited by small sample sizes. Future analyses should make use of data from Sero7 and additional sero-surveys (the uptake of CO-HTC is expected to be higher at these rounds), and/or pool data from different subsets of sero-survey rounds, in order to increase sample sizes. Future sero-surveys should also promote, and capture usage of, couples-HTC. This mode of testing has been associated with significant reductions in sexual risk behaviour among sero-discordant couples (106, 107, 211), but its impact among sero-concordant couples is less well documented. Future quantitative and qualitative research could explore barriers and facilitating factors to the use of couples-HTC services, and the impact of couples-HTC on sexual risk behaviour, while qualitative research could explore the impact of HTC on reproductive health decisions, in addition to sexual behaviour.

9.5.4 Development of data linkage techniques

Although the linkage of users of the health centre HTC services to the Kisesa cohort dataset represented a significant advancement in terms of the development of the methodology, the linkage procedures could be optimised and improved. Modifications to the weighting and scoring schemes used might reduce the numbers

of multiple research-participant matches for each clinic record, while migration reconciliation procedures within the demographic surveillance system (DSS) dataset would allow identification of which DSS ID numbers actually represented the same person. To deal with sub-optimal systems for recording unique ID numbers for return clients at the WI-HTC clinic, the HTC clinic dataset could first be mapped or linked onto itself, in order to identify unique clients which were represented by different ID numbers within the clinic logbooks.

Analysis methods might be improved by using weighted regression or multiple imputation techniques, in order to investigate the effect of selecting different potential 'best' DSS matches for a unique clinic ID on the outcomes investigated. Finally, methods for prospective or 'real-time' data linkage could be implemented in Kisesa. These could make use of DSS ID cards which are currently being developed for all residents in the study area, by recording an individual's DSS ID card number in clinic logbooks at the time of service use, and/or making use of databases containing photographs, which are also included on the DSS ID cards.

9.6 Dissemination of research findings

The research findings have already been, or shortly will be, disseminated to a broad audience including the local community in Kisesa, programme managers and policy makers in Tanzania, and the wider research and academic community working in the field of HIV prevention.

9.6.1 Healthcare workers and community members in Kisesa

I will communicate key findings from the study to healthcare workers providing services during sero-surveys and at Kisesa Health Centre, through preparation of a short report. This will summarise the main findings and recommendations from the research. Issues relating to aspects of service provision by counsellors and nurses will be discussed in a sensitive and constructive way. The key findings from the research will also be fed back to healthcare workers through face to face meetings, with the assistance of TAZAMA Project staff.

In order that community members may see the output and recommendations arising out of their participation in the research, and that they may benefit from it, the main findings from this study will be fed back to community members through community meetings organised by the village AIDS committees. This will be done with the assistance of TAZAMA Project staff as well as Tanzanian social scientists and/or the fieldworkers who were involved in the qualitative research. Key messages will be presented in plain language, and the policy recommendations which have been made will also be included.

9.6.2 National and district health authorities

The findings from this research will be relevant for district and national health authorities as they plan and implement HIV treatment and prevention programmes around Tanzania. The key findings from the research will be presented to health officials within Magu District as well as at the National AIDS Control Programme (NACP) in Dar es Salaam through preparation of a report. This will focus on the relevance of the lessons learned in Kisesa to other settings in Tanzania, and how the policy recommendations might apply. I also expect to travel to Dar es Salaam in June 2015, providing an opportunity to disseminate findings to relevant members of staff at the NACP through face to face meetings and/or presentations.

9.6.3 Sharing of data, research methods and data collection tools

The linked WI-HTC clinic-cohort dataset will be stored on secure project servers at the London School of Hygiene and Tropical Medicine (LSHTM) and the National Institute for Medical Research (NIMR) in Mwanza, and made available for future researchers working with the TAZAMA Project, subject to approvals by the principal investigators at LSHTM and NIMR. The data linkage methodology will also be shared with relevant TAZAMA researchers, or with other researchers working at similar demographic surveillance sites across sub-Saharan Africa, where relevant. There is already a new PhD project underway in Kisesa, with the aim of piloting and implementing a new real-time data linkage system at the WI-HTC and other clinics at the health centre, and various documents and project learnings have already been shared with this student via email and face-to-face meetings.

Subject to permissions, the qualitative dataset will also be made available to future researchers exploring the uptake and impact of HTC services in Kisesa, and may be used as part of a current study exploring bottlenecks along the HIV diagnosis-to-care continuum, with a particular focus on barriers at the point of HTC uptake. The qualitative data collection tools have already been shared with researchers working on this project in order to avoid duplication of efforts, and other project learnings and insights in terms of recruitment and study design are also likely to be shared.

9.6.4 Researchers – academic publications and conferences

Two of the papers presented in this thesis (Papers B and C) have already been published in peer reviewed open access journals with a wide international readership, while two additional papers (Papers A and D) are currently under review. The quantitative analyses presented in Chapter 6 (Paper C – impact of CO-HTC on sexual behaviour change and HIV incidence) was chosen for inclusion in the 4th issue of 'HIV this month' 2014 (213), which is a monthly review of articles compiled by 'UNAIDS Science now' to provide updated scientific information to UNAIDS staff and other professionals, with selection from close to a thousand articles each month. A further publication is likely to be prepared based on the systematic review of the impact of HTC on sexual behaviour change and HIV incidence presented in Chapter 2. In addition to the papers arising directly out of the research, I have also co-authored on three additional papers, one assessing the impact of HIV and ART knowledge on HTC use (214) and two using similar data linkage methods to those presented in this thesis to assess the uptake of PMTCT services in Kisesa (215, 216).

In addition to the scientific publications prepared, the following presentations were made at international conferences (posters or slide sets are included in Appendix 11.5):

Appendix 11.5.1: Caoimhe Cawley, Alison Wringe, Mark Urassa, Raphael Isingo, Jim Todd, Yususfu Kumogola et al. Socio-demographic and clinical factors associated with repeat HIV testing and counseling in a community cohort study in

north-west Tanzania: Oral presentation; 16th International Conference on AIDS & STDS in Africa (ICASA), Addis Ababa, December 2011.

This was a precursor to the analyses presented in Chapter 5 (Paper B), assessing socio-demographic and clinical factors associated with repeat testing among individuals attending Sero4 and Sero5. The analyses were later adapted to assess repeat testing among individuals attending Sero5 and Sero6, due to greater data availability at this subset of rounds.

Appendix 11.5.2: Caoimhe Cawley, Alison Wringe, Rose Manyalla, Yusufu Kumogola, Benjamin Clark, Raphael Isingo et al. The role of voluntary counseling and testing in HIV prevention and sexual behaviour change: Poster presentation; 16th ICASA, Addis Ababa, December 2011.

This was a precursor to the analyses presented in Chapter 6 (Paper C), and explored changes in sexual risk behaviour among individuals attending Sero4 and Sero5 using logistic regression. Analyses methods were later refined to incorporate an additional set of sero-survey rounds (Sero5 and Sero6) using multinomial logistic regression, which was better suited to investigate multiple outcomes (decrease, increase or no change in sexual risk behaviour).

Appendix 11.5.3: Caoimhe Cawley, Alison Wringe, Benjamin Clark, Clemens Masesa, Annabelle Gourlay, Richard Machemba et al. Access to HIV testing and counselling services in rural Tanzania by mode of service delivery: Oral presentation; HIV/AIDS: Interdisciplinary Perspectives, Bayreuth, Germany, September 2014.

This was a presentation of the main findings from the analyses presented in Chapter 4 (Paper A).

An additional abstract (included in Appendix 11.5.4) based on the findings arising out of the qualitative research has been accepted for a poster presentation at the 8th International AIDS Conference on HIV Pathogenesis, Treatment and Prevention in Vancouver in July 2015:

Caoimhe Cawley, Alison Wringe, Shelley Lees, Joyce Wamoyi, Ray Nsigaye, Mark Urassa. It is just the way it was in the past before I went to test'. Exploring the role of HIV prevention counselling in sexual behaviour change in rural Tanzania

9.7 Concluding remarks

Despite encouraging increases over time, the uptake and coverage of HTC services remains suboptimal in Kisesa, and ultimately this results in missed opportunities in terms of their potential contribution to HIV education and prevention efforts. Groups which are particularly underserved include those living in rural villages, those with least education, men who are HIV-negative or of unknown status, and HIV-positive women. Programmes should be implemented which aim to increase coverage among these groups, and future research should monitor whether such programmes and interventions have been successful, as well as which services most effectively link HIV-positive individuals to treatment and care services. The traditional client initiated WI-HTC service was most successful in attracting HIV-positive individuals, although the evidence suggests that the largest overall proportions of HIV-positive individuals were diagnosed via CO-HTC. However, the relative success of the different HTC strategies in attracting HIV-positive individuals at early stages of infection was unclear, and future analyses should explore this using larger sample sizes.

The findings from the research provided moderate evidence for an impact of HTC on reductions in sexual risk behaviour among HIV-negative individuals, but highlighted several socio-cultural and structural barriers which inhibited behaviour change. These included sexual decision-making and relationship dynamics, which constrained the extent to which women in particular felt able to control their exposure to HIV risk, which was seen as inherently linked to their partners' behaviour. Counselling techniques and approaches which help counsellors to encourage an exchange of information during counselling sessions, and which include more culturally relevant counselling messages, may help to improve the effectiveness of HTC as an HIV-prevention intervention in a rural African setting such as Kisesa.

10 References

1. UNAIDS. Getting to zero: HIV in eastern and southern Africa. Geneva, Switzerland: 2013.
2. UNAIDS. AIDSinfo [24/02/2015]. Available from: <http://www.unaids.org/en/dataanalysis/datatools/aidsinfo/?geoitem=TZA&edition=WORLD>.
3. WHO, UNAIDS, UNICEF. Towards Universal Access: Scaling up priority HIV/AIDS interventions in the health sector. Progress Report 2010. Geneva, Switzerland: 2010.
4. WHO. Source book for HIV/AIDS counselling training. Geneva: WHO; 1994.
5. UNAIDS. Counselling and HIV/AIDS. UNAIDS Technical Update. Geneva, Switzerland: 1997.
6. Ministry of Health. National Guidelines for Voluntary Counselling and Testing, 2005. Tanzania: 2005.
7. De Cock KM, Bunnell R, Mermin J. Unfinished business--expanding HIV testing in developing countries. The New England journal of medicine. 2006;354(5):440-2.
8. Baggaley R, Hensen B, Ajose O, Grabbe KL, Wong VJ, Schilsky A, et al. From caution to urgency: the evolution of HIV testing and counselling in Africa. Bull World Health Organ. 2012;90(9):652-8B.
9. Ministry of Health and Social Welfare. Guidelines for HIV testing and counselling in clinical settings. Tanzania: 2007.
10. Matovu JK, Makumbi FE. Expanding access to voluntary HIV counselling and testing in sub-Saharan Africa: alternative approaches for improving uptake, 2001-2007. Trop Med Int Health. 2007;12(11):1315-22.
11. Suthar AB, Ford N, Bachanas PJ, Wong VJ, Rajan JS, Saltzman AK, et al. Towards universal voluntary HIV testing and counselling: a systematic review and meta-analysis of community-based approaches. PLoS Med. 2013;10(8):e1001496.
12. Prime Minister's Office. Tanzania third national multi-sectoral strategic framework for HIV and AIDS (2013/14 - 2017/18). Tanzania: 2013.
13. Tanzania Commission for AIDS (TACAIDS) NBoS, ORC Macro. Tanzania HIV/AIDS Indicator Survey 2003-04. Tanzania: 2005.
14. Tanzania Commission for AIDS (TACAIDS) ZAC, National Bureau of Statistics, Office of the Chief Government Statistician, Macro International Inc. Tanzania HIV/AIDS and Malaria Indicator Survey 2007-08. Dar es Salaam, Tanzania: 2008.
15. Tanzania Commission for AIDS (TACAIDS) ZAC, National Bureau of Statistics, Office of the Chief Government Statistician, ICF International. Tanzania HIV/AIDS and Malaria Indicator Survey 2011-12. Dar es Salaam, Tanzania: 2013.
16. Roura M, Urassa M, Busza J, Mbata D, Wringe A, Zaba B. Scaling up stigma? The effects of antiretroviral roll-out on stigma and HIV testing. Early evidence from rural Tanzania. Sex Transm Infect. 2009;85(4):308-12.
17. de Paoli MM, Manongi R, Klepp KI. Factors influencing acceptability of voluntary counselling and HIV-testing among pregnant women in Northern Tanzania. AIDS Care. 2004;16(4):411-25.
18. Mlay R, Lugina H, Becker S. Couple counselling and testing for HIV at antenatal clinics: views from men, women and counsellors. AIDS Care. 2008;20(3):356-60.
19. Maman S, Mbwambo J, Hogan NM, Kilonzo GP, Sweat M. Women's barriers to HIV-1 testing and disclosure: challenges for HIV-1 voluntary counselling and testing. AIDS Care. 2001;13(5):595-603.

20. WHO. Scaling-up HIV testing and counselling services: a toolkit for programme managers Geneva 2005. Available from: <http://www.who.int/hiv/pub/vct/toolkit/en/index.html>.
21. UNAIDS. Voluntary Counselling and Testing Technical Update. Geneva: 2000.
22. Denison JA, O'Reilly KR, Schmid GP, Kennedy CE, Sweat MD. HIV voluntary counseling and testing and behavioral risk reduction in developing countries: a meta-analysis, 1990--2005. *Aids Behav.* 2008;12(3):363-73.
23. Fonner VA, Denison J, Kennedy CE, O'Reilly K, Sweat M. Voluntary counseling and testing (VCT) for changing HIV-related risk behavior in developing countries. *Cochrane database of systematic reviews (Online)*. 2012;9:Cd001224.
24. Sherr L, Lopman B, Kakowa M, Dube S, Chawira G, Nyamukapa C, et al. Voluntary counselling and testing: uptake, impact on sexual behaviour, and HIV incidence in a rural Zimbabwean cohort. *Aids.* 2007;21(7):851-60.
25. Shafer LA, Nsubuga RN, White R, Mayanja BN, Chapman R, O'Brien K, et al. Antiretroviral therapy and sexual behavior in Uganda: a cohort study. *Aids.* 2011;25(5):671-8.
26. Allen C, Mbonye M, Seeley J, Birungi J, Wolff B, Coutinho A, et al. ABC for people with HIV: responses to sexual behaviour recommendations among people receiving antiretroviral therapy in Jinja, Uganda. *Cult Health Sex.* 2011;13(5):529-43.
27. McArthur M, Birdthistle I, Seeley J, Mpendo J, Asiki G. How HIV diagnosis and disclosure affect sexual behavior and relationships in Ugandan fishing communities. *Qual Health Res.* 2013;23(8):1125-37.
28. Lifshay J, Nakayiwa S, King R, Reznick OG, Katuntu D, Batamwita R, et al. Partners at risk: motivations, strategies, and challenges to HIV transmission risk reduction among HIV-infected men and women in Uganda. *AIDS Care.* 2009;21(6):715-24.
29. King R, Lifshay J, Nakayiwa S, Katuntu D, Lindkvist P, Bunnell R. The virus stops with me: HIV-infected Ugandans' motivations in preventing HIV transmission. *Soc Sci Med.* 2009;68(4):749-57.
30. Granich RM, Gilks CF, Dye C, De Cock KM, Williams BG. Universal voluntary HIV testing with immediate antiretroviral therapy as a strategy for elimination of HIV transmission: a mathematical model. *Lancet.* 2009;373(9657):48-57.
31. Cohen MS, Chen YQ, McCauley M, Gamble T, Hosseinipour MC, Kumarasamy N, et al. Prevention of HIV-1 infection with early antiretroviral therapy. *The New England journal of medicine.* 2011;365(6):493-505.
32. The HIV Modelling Consortium Treatment as Prevention Editorial Writing Group. HIV treatment as prevention: models, data, and questions--towards evidence-based decision-making. *PLoS Med.* 2012;9(7):e1001259. doi: 10.1371/journal.pmed.. Epub 2012 Jul 10.
33. WHO. Consolidated guidelines on the use of antiretroviral drugs for treating and preventing HIV infection. Geneva, Switzerland: 2013.
34. WHO. Antiretroviral therapy for HIV infection in adults and adolescents - recommendations for a public health approach. Geneva, Switzerland: 2010.
35. Barnighausen T, Eyal N, Wikler D. HIV Treatment-as-Prevention Research at a Crossroads. *PLoS Med.* 2014;11(6):e1001654. doi: 10.1371/journal.pmed.. eCollection 2014 Jun.
36. Ministry of Health and Social Welfare. National Guidelines for Comprehensive Care Services for Prevention of Mother-to-Child Transmission of HIV and Keeping Mothers Alive. Dar es Salaam, Tanzania: 2013.
37. Geis S, Maboko L, Saathoff E, Hoffmann O, Geldmacher C, Mmbando D, et al. Risk factors for HIV-1 infection in a longitudinal, prospective cohort of adults from the Mbeya Region, Tanzania. *J Acquir Immune Defic Syndr.* 2011;56(5):453-9.

38. Lopman B, Nyamukapa C, Mushati P, Mupambireyi Z, Mason P, Garnett GP, et al. HIV incidence in 3 years of follow-up of a Zimbabwe cohort--1998-2000 to 2001-03: contributions of proximate and underlying determinants to transmission. *Int J Epidemiol.* 2008;37(1):88-105.
39. Boileau C, Clark S, Bignami-Van Assche S, Poulin M, Reniers G, Watkins SC, et al. Sexual and marital trajectories and HIV infection among ever-married women in rural Malawi. *Sex Transm Infect.* 2009;85 Suppl 1:i27-33.
40. Cremin I, Cauchemez S, Garnett GP, Gregson S. Patterns of uptake of HIV testing in sub-Saharan Africa in the pre-treatment era. *Trop Med Int Health.* 2012;17(8):e26-37.
41. Staveteig SE, Bradley SE, Nybro E, Wang S. Demographic patterns of HIV testing uptake in sub-Saharan Africa. Calverton, Maryland, USA: ICF International: 2013.
42. Wringe A, Isingo R, Urassa M, Maiseli G, Manyalla R, Chagalucha J, et al. Uptake of HIV voluntary counselling and testing services in rural Tanzania: implications for effective HIV prevention and equitable access to treatment. *Trop Med Int Health.* 2008;13(3):319-27.
43. Isingo R, Wringe A, Todd J, Urassa M, Mbata D, Maiseli G, et al. Trends in the uptake of voluntary counselling and testing for HIV in rural Tanzania in the context of the scale up of antiretroviral therapy. *Trop Med Int Health.* 2012;17(8):e15-25.
44. Bayer R, Edington C. HIV testing, human rights, and global AIDS policy: exceptionalism and its discontents. *J Health Polit Policy Law.* 2009;34(3):301-23.
45. Centers for Disease Control (CDC). Additional recommendations to reduce sexual and drug abuse-related transmission of human T-lymphotropic virus type III/lymphadenopathy-associated virus. *MMWR Morbidity and mortality weekly report.* 1986;35(10):152-5.
46. Angotti N. Working outside of the box: how HIV counselors in Sub-Saharan Africa adapt Western HIV testing norms. *Soc Sci Med.* 2010;71(5):986-93.
47. UNAIDS, WHO. UNAIDS/WHO policy statement on HIV testing. Geneva, Switzerland: 2004.
48. WHO. Guidance on provider-initiated HIV testing and counselling in health facilities. Geneva, Switzerland: 2007.
49. UNAIDS. Declaration of Commitment on HIV/AIDS. Geneva, Switzerland: 2001.
50. WHO. Treating 3 million by 2005: making it happen: the WHO strategy. Geneva, Switzerland: 2003.
51. UNAIDS. Political Declaration on HIV/AIDS 2006 [02/04/2015]. Available from: <http://www.unaids.org/en/aboutunaids/unitednationsdeclarationsandgoals/2006politicaldeclarationonhivaids>.
52. Downing RG, Otten RA, Marum E, Biryahwaho B, Alwano-Edyegu MG, Sempala SD, et al. Optimizing the delivery of HIV counseling and testing services: the Uganda experience using rapid HIV antibody test algorithms. *J Acquir Immune Defic Syndr Hum Retrovirol.* 1998;18(4):384-8.
53. Loutfy MR, Wu W, Letchumanan M, Bondy L, Antoniou T, Margolese S, et al. Systematic review of HIV transmission between heterosexual serodiscordant couples where the HIV-positive partner is fully suppressed on antiretroviral therapy. *PLoS ONE.* 2013;8(2):e55747.
54. Kennedy CE, Fonner VA, Sweat MD, Okero FA, Baggaley R, O'Reilly KR. Provider-Initiated HIV Testing and Counseling in Low- and Middle-Income Countries: A Systematic Review. *Aids Behav.* 2012.
55. Roura M, Watson-Jones D, Kahawita TM, Ferguson L, Ross DA. Provider-initiated testing and counselling programmes in sub-Saharan Africa: a systematic review of their operational implementation. *Aids.* 2013;27(4):617-26.

56. Hensen B, Baggaley R, Wong VJ, Grabbe KL, Shaffer N, Lo YR, et al. Universal voluntary HIV testing in antenatal care settings: a review of the contribution of provider-initiated testing & counselling. *Trop Med Int Health*. 2012;17(1):59-70.
57. MacPherson P, MacPherson EE, Mwale D, Bertel Squire S, Makombe SD, Corbett EL, et al. Barriers and facilitators to linkage to ART in primary care: a qualitative study of patients and providers in Blantyre, Malawi. *J Int AIDS Soc*. 2012;15(2):18020.
58. Gourlay A, Wringe A, Birdthistle I, Mshana G, Michael D, Urassa M. "It is like that, we didn't understand each other": exploring the influence of patient-provider interactions on prevention of mother-to-child transmission of HIV service use in rural Tanzania. *PLoS ONE*. 2014;9(9):e106325.
59. Obermeyer CM, Neuman M, Desclaux A, Wanyenze R, Ky-Zerbo O, Cherutich P, et al. Associations between mode of HIV testing and consent, confidentiality, and referral: a comparative analysis in four African countries. *PLoS Med*. 2012;9(10):e1001329.
60. Leon NH, Colvin CJ, Lewin S, Mathews C, Jennings K. Provider-initiated testing and counselling for HIV - from debate to implementation. *S Afr Med J*. 2010;100(4):220-1.
61. Corbett EL, Dauya E, Matambo R, Cheung YB, Makamure B, Bassett MT, et al. Uptake of workplace HIV counselling and testing: a cluster-randomised trial in Zimbabwe. *PLoS Med*. 2006;3(7):e238.
62. Khumalo-Sakutukwa G, Morin SF, Fritz K, Charlebois ED, van Rooyen H, Chingono A, et al. Project Accept (HPTN 043): a community-based intervention to reduce HIV incidence in populations at risk for HIV in sub-Saharan Africa and Thailand. *J Acquir Immune Defic Syndr*. 2008;49(4):422-31.
63. Sweat M, Morin S, Celentano D, Mulawa M, Singh B, Mbwanbo J, et al. Community-based intervention to increase HIV testing and case detection in people aged 16-32 years in Tanzania, Zimbabwe, and Thailand (NIMH Project Accept, HPTN 043): a randomised study. *The Lancet Infectious Diseases*. 2011;11(7):525-32.
64. Grabbe KL, Menzies N, Taegtmeyer M, Emukule G, Angala P, Mwega I, et al. Increasing access to HIV counseling and testing through mobile services in Kenya: strategies, utilization, and cost-effectiveness. *J Acquir Immune Defic Syndr*. 2010;54(3):317-23.
65. Morin SF, Khumalo-Sakutukwa G, Charlebois ED, Routh J, Fritz K, Lane T, et al. Removing barriers to knowing HIV status: same-day mobile HIV testing in Zimbabwe. *J Acquir Immune Defic Syndr*. 2006;41(2):218-24.
66. Ostermann J, Reddy EA, Shorter MM, Muiruri C, Mitalo A, Itemba DK, et al. Who tests, who doesn't, and why? Uptake of mobile HIV counseling and testing in the Kilimanjaro Region of Tanzania. *PLoS ONE*. 2011;6(1):e16488.
67. Menzies N, Abang B, Wanyenze R, Nuwaha F, Mugisha B, Coutinho A, et al. The costs and effectiveness of four HIV counseling and testing strategies in Uganda. *Aids*. 2009;23(3):395-401.
68. HELLINGER S, KOHLER HP, FRIMPOG JA, MKANDAWIRE J. Increasing Uptake of HIV Testing and Counseling Among the Poorest in Sub-Saharan Countries Through Home-based service provision. *J Acquir Immune Defic Syndr*. 2009;51(2):185-93.
69. Lugada E, Levin J, Abang B, Mermin J, Mugalanzi E, Namara G, et al. Comparison of home and clinic-based HIV testing among household members of persons taking antiretroviral therapy in Uganda: results from a randomized trial. *J Acquir Immune Defic Syndr*. 2010;55(2):245-52.
70. Sabapathy K, Van den Bergh R, Fidler S, Hayes R, Ford N. Uptake of Home-Based Voluntary HIV Testing in Sub-Saharan Africa: A Systematic Review and Meta-Analysis. *PLoS Med*. 2012;9(12):e1001351.

71. Angotti N, Bula A, Gaydos H, Kimchi EZ, Thornton RL, Yeatman SE. Increasing the acceptability of HIV counseling and testing with three C's: convenience, confidentiality and credibility. *Soc Sci Med*. 2009;68(12):2263-70.
72. Were W, Mermin J, Bunnell R, Ekwaru JP, Kaharuza F. Home-based model for HIV voluntary counselling and testing. *Lancet*. 2003;361(9368):1569.
73. Johnson C, Baggaley R, Forsythe S, van Rooyen H, Ford N, Napierala Mavedzenge S, et al. Realizing the potential for HIV self-testing. *Aids Behav*. 2014;18 Suppl 4:S391-5.
74. Choko AT, Desmond N, Webb EL, Chavula K, Napierala-Mavedzenge S, Gaydos CA, et al. The uptake and accuracy of oral kits for HIV self-testing in high HIV prevalence setting: a cross-sectional feasibility study in Blantyre, Malawi. *PLoS Med*. 2011;8(10):e1001102.
75. Asiimwe S, Oloya J, Song X, Whalen CC. Accuracy of un-supervised versus provider-supervised self-administered HIV testing in Uganda: A randomized implementation trial. *Aids Behav*. 2014;18(12):2477-84.
76. Hood JE, MacKellar D, Spaulding A, Nelson R, Mosiakgabo B, Sikwa B, et al. Client characteristics and gender-specific correlates of testing HIV positive: a comparison of standalone center versus mobile outreach HIV testing and counseling in Botswana. *Aids Behav*. 2012;16(7):1902-16.
77. van Schaik N, Kranzer K, Wood R, Bekker LG. Earlier HIV diagnosis--are mobile services the answer? *S Afr Med J*. 2010;100(10):671-4.
78. Obermeyer CM, Neuman M, Hardon A, Desclaux A, Wanyenze R, Ky-Zerbo O, et al. Socio-economic determinants of HIV testing and counselling: a comparative study in four African countries. *Trop Med Int Health*. 2013;18(9):1110-8.
79. Ziraba AK, Madise NJ, Kimani JK, Oti S, Mgomella G, Matilu M, et al. Determinants for HIV testing and counselling in Nairobi urban informal settlements. *BMC Public Health*. 2011;11:663.
80. Peltzer K, Matseke G, Mzolo T, Majaja M. Determinants of knowledge of HIV status in South Africa: results from a population-based HIV survey. *BMC Public Health*. 2009;9:174.
81. Johnston L, O'Bra H, Chopra M, Mathews C, Townsend L, Sabin K, et al. The associations of voluntary counseling and testing acceptance and the perceived likelihood of being HIV-infected among men with multiple sex partners in a South African township. *Aids Behav*. 2010;14(4):922-31.
82. Cohen MS, Smith MK, Muessig KE, Hallett TB, Powers KA, Kashuba AD. Antiretroviral treatment of HIV-1 prevents transmission of HIV-1: where do we go from here? *Lancet*. 2013;382(9903):1515-24.
83. Matovu JK, Gray RH, Kiwanuka N, Kigozi G, Wabwire-Mangen F, Nalugoda F, et al. Repeat voluntary HIV counseling and testing (VCT), sexual risk behavior and HIV incidence in Rakai, Uganda. *Aids Behav*. 2007;11(1):71-8.
84. Obare F, Fleming P, Anglewicz P, Thornton R, Martinson F, Kapatuka A, et al. Acceptance of repeat population-based voluntary counselling and testing for HIV in rural Malawi. *Sex Transm Infect*. 2009;85(2):139-44.
85. Venkatesh KK, Madiba P, De Bruyn G, Lurie MN, Coates TJ, Gray GE. Who gets tested for HIV in a South African urban township? Implications for test and treat and gender-based prevention interventions. *J Acquir Immune Defic Syndr*. 2011;56(2):151-65.
86. Regan S, Losina E, Chetty S, Giddy J, Walensky RP, Ross D, et al. Factors associated with self-reported repeat HIV testing after a negative result in Durban, South Africa. *PLoS ONE*. 2013;8(4):e62362.
87. Kranzer K, van Schaik N, Karmue U, Middelkoop K, Sebastian E, Lawn SD, et al. High prevalence of self-reported undiagnosed HIV despite high coverage of HIV testing: a cross-sectional population based sero-survey in South Africa. *PLoS ONE*. 2011;6(9):e25244.

88. Bradley H, Tsui A, Kidanu A, Gillespie D. Client characteristics and HIV risk associated with repeat HIV testing among women in Ethiopia. *Aids Behav.* 2011;15(4):725-33.
89. Higgins DL, Galavotti C, O'Reilly KR, Schnell DJ, Moore M, Rugg DL, et al. Evidence for the effects of HIV antibody counseling and testing on risk behaviors. *JAMA.* 1991;266(17):2419-29.
90. Wolitski RJ, MacGowan RJ, Higgins DL, Jorgensen CM. The effects of HIV counseling and testing on risk-related practices and help-seeking behavior. *AIDS Educ Prev.* 1997;9(3 Suppl):52-67.
91. Weinhardt LS, Carey MP, Johnson BT, Bickham NL. Effects of HIV counseling and testing on sexual risk behavior: a meta-analytic review of published research, 1985-1997. *Am J Public Health.* 1999;89(9):1397-405.
92. Mola OD, Mercer MA, Asghar RJ, Gimbel-Sherr KH, Gimbel-Sherr S, Micek MA, et al. Condom use after voluntary counselling and testing in central Mozambique. *Trop Med Int Health.* 2006;11(2):176-81.
93. Arthur G, Nduba V, Forsythe S, Mutemi R, Odhiambo J, Gilks C. Behaviour change in clients of health centre-based voluntary HIV counselling and testing services in Kenya. *Sex Transm Infect.* 2007;83(7):541-6.
94. Peltzer K, Tabane C, Matseke G, Simbayi L. Lay counsellor-based risk reduction intervention with HIV positive diagnosed patients at public HIV counselling and testing sites in Mpumalanga, South Africa. *Eval Program Plann.* 2010;33(4):379-85.
95. Fiorillo SP, Landman KZ, Tribble AC, Mtalo A, Itemba DK, Ostermann J, et al. Changes in HIV risk behavior and seroincidence among clients presenting for repeat HIV counseling and testing in Moshi, Tanzania. *AIDS Care.* 2012;24(10):1264-71.
96. The Voluntary HIV-1 Counseling and Testing Efficacy Study Group. Efficacy of voluntary HIV-1 counselling and testing in individuals and couples in Kenya, Tanzania, and Trinidad: a randomised trial. *Lancet.* 2000;356(9224):103-12.
97. Coates TJ, Kulich M, Celentano DD, Zelaya CE, Chariyalertsak S, Chingono A, et al. Effect of community-based voluntary counselling and testing on HIV incidence and social and behavioural outcomes (NIMH Project Accept; HPTN 043): a cluster-randomised trial. *Lancet Glob Health.* 2014;2(5):e267-77.
98. Doherty T, Tabana H, Jackson D, Naik R, Zembe W, Lombard C, et al. Effect of home based HIV counselling and testing intervention in rural South Africa: cluster randomised trial. *BMJ (Clinical research ed).* 2013;346:f3481.
99. Matovu JKB, Gray RH, Makumbi F, Wawer MJ, Serwadda D, Kigozi G, et al. Voluntary HIV counseling and testing acceptance, sexual risk behavior and HIV incidence in Rakai, Uganda. *Aids.* 2005;19(5):503-11.
100. Cremin I, Nyamukapa C, Sherr L, Hallett TB, Chawira G, Cauchemez S, et al. Patterns of self-reported behaviour change associated with receiving voluntary counselling and testing in a longitudinal study from Manicaland, Zimbabwe. *Aids Behav.* 2010;14(3):708-15.
101. Rosenberg NE, Westreich D, Barnighausen T, Miller WC, Behets F, Maman S, et al. Assessing the effect of HIV counselling and testing on HIV acquisition among South African youth. *Aids.* 2013;27(17):2765-73.
102. Turner AN, Miller WC, Padian NS, Kaufman JS, Behets FM, Chipato T, et al. Unprotected sex following HIV testing among women in Uganda and Zimbabwe: short- and long-term comparisons with pre-test behaviour. *Int J Epidemiol.* 2009;38(4):997-1007.
103. Matambo R, Dauya E, Mutswanga J, Makanza E, Chandiwan S, Mason PR, et al. Voluntary counseling and testing by nurse counselors: what is the role of routine repeated testing after a negative result? *Clinical infectious diseases : an official publication of the Infectious Diseases Society of America.* 2006;42(4):569-71.

104. Venkatesh KK, de Bruyn G, Mayer KH, Cheng H, Blanchard K, Ramjee G, et al. Changes in sexual risk behavior before and after HIV seroconversion in Southern African women enrolled in a HIV prevention trial. *J Acquir Immune Defic Syndr*. 2011;57(5):435-41.
105. Nuwaha F, Kasasa S, Wana G, Muganzi E, Tumwesigye E. Effect of home-based HIV counselling and testing on stigma and risky sexual behaviours: serial cross-sectional studies in Uganda. *J Int AIDS Soc*. 2012;15(2):17423.
106. Roth DL, Stewart KE, Clay OJ, van Der Straten A, Karita E, Allen S. Sexual practices of HIV discordant and concordant couples in Rwanda: effects of a testing and counselling programme for men. *Int J STD AIDS*. 2001;12(3):181-8.
107. Allen S, Meinzen-Derr J, Kautzman M, Zulu I, Trask S, Fideli U, et al. Sexual behavior of HIV discordant couples after HIV counseling and testing. *Aids*. 2003;17(5):733-40.
108. Jones DJ, Chitalu N, Ndubani P, Mumbi M, Weiss SM, Villar-Loubet O, et al. Sexual risk reduction among Zambian couples. *Sahara J*. 2009;6(2):69-75.
109. Maman S, Moodley D, McNaughton-Reyes HL, Groves AK, Kagee A, Moodley P. Efficacy of enhanced HIV counseling for risk reduction during pregnancy and in the postpartum period: a randomized controlled trial. *PLoS ONE*. 2014;9(5):e97092.
110. Farquhar C, Kiarie JN, Richardson BA, Kabura MN, John FN, Nduati RW, et al. Antenatal couple counseling increases uptake of interventions to prevent HIV-1 transmission. *J Acquir Immune Defic Syndr*. 2004;37(5):1620-6.
111. Desgrees-Du-Lou A, Brou H, Djohan G, Becquet R, Ekouevi DK, Zanou B, et al. Beneficial effects of offering prenatal HIV counselling and testing on developing a HIV preventive attitude among couples. Abidjan, 2002-2005. *Aids Behav*. 2009;13(2):348-55.
112. Kiene SM, Bateganya M, Wanyenze R, Lule H, Nantaba H, Stein MD. Initial outcomes of provider-initiated routine HIV testing and counseling during outpatient care at a rural Ugandan hospital: risky sexual behavior, partner HIV testing, disclosure, and HIV care seeking. *AIDS Patient Care STDS*. 2010;24(2):117-26.
113. Denison JA. Behaviour change: A summary of four major theories. Arlington: Family Health International, 1996.
114. UNAIDS. Sexual behavioural change for HIV: Where have theories taken us? Geneva, Switzerland: 1999.
115. Airhihenbuwa CO, Obregon R. A critical assessment of theories/models used in health communication for HIV/AIDS. *J Health Commun*. 2000;5 Suppl:5-15.
116. McLeroy KR, Bibeau D, Steckler A, Glanz K. An ecological perspective on health promotion programs. *Health Educ Q*. 1988;15(4):351-77.
117. Becker MH. The health belief model and personal health behavior. *Health Education Monographs*. 1974;2:324-508.
118. Janz NK, Becker MH. The Health Belief Model: a decade later. *Health Educ Q*. 1984;11(1):1-47.
119. Hounton SH, Carabin H, Henderson NJ. Towards an understanding of barriers to condom use in rural Benin using the Health Belief Model: a cross sectional survey. *BMC Public Health*. 2005;5:8.
120. Adih WK, Alexander CS. Determinants of condom use to prevent HIV infection among youth in Ghana. *J Adolesc Health*. 1999;24(1):63-72.
121. Wilson DJ, Lavelle S, Hood R. Health knowledge and beliefs as predictors of intended condom use among Zimbabwean adolescents in probation/remand homes. *AIDS Care*. 1990;2(3):267-74.
122. Prochaska JO, DiClemente CC, Norcross JC. In search of how people change. Applications to addictive behaviors. *Am Psychol*. 1992;47(9):1102-14.
123. Galavotti C, Cabral RJ, Lansky A, Grimley DM, Riley GE, Prochaska JO. Validation of measures of condom and other contraceptive use among women at

- high risk for HIV infection and unintended pregnancy. *Health Psychol.* 1995;14(6):570-8.
124. Prochaska JO, Redding CA, Harlow LL, Rossi JS, et al. The transtheoretical model of change and HIV prevention: A review. *Health Education Quarterly.* 1994;21(4):471-86.
 125. Centers for Disease Control (CDC). Distribution of STD clinic patients along a stages-of-behavioral-change continuum--selected sites, 1993. *MMWR Morbidity and mortality weekly report.* 1993;42(45):880-3.
 126. Fishbein M, Middlestadt SE, Hitchcock PJ. Using information to change sexually transmitted disease-related behaviours. In: DiClemente RJ, Peterson JL, editors. *Preventing AIDS: theories and methods of behavioral interventions.* New York 1994. p. 61-78.
 127. VanLandingham MJ, Suprasert S, Grandjean N, Sittitrai W. Two views of risky sexual practices among northern Thai males: the Health Belief Model and the Theory of Reasoned Action. *J Health Soc Behav.* 1995;36(2):195-212.
 128. Fishbein M. The role of theory in HIV prevention. *AIDS Care.* 2000;12(3):273-8.
 129. Sethosa E, Peltzer K. Evaluation of HIV counselling and testing, self-disclosure, social support and sexual behaviour change among a rural sample of HIV reactive patients in South Africa. *Curationis.* 2005;28(1):29-41.
 130. Sikasote J, Grant L, Chinn DJ, Macwang'i M, Murray SA. Voluntary counselling and testing for HIV in a Zambian mining community: serial interviews with people testing negative. *Sex Transm Infect.* 2011;87(5):433-8.
 131. Sarna A, Chersich M, Okal J, Luchters SM, Mandaliya KN, Rutenberg N, et al. Changes in sexual risk taking with antiretroviral treatment: influence of context and gender norms in Mombasa, Kenya. *Cult Health Sex.* 2009;11(8):783-97.
 132. Musheke M, Bond V, Merten S. Couple experiences of provider-initiated couple HIV testing in an antenatal clinic in Lusaka, Zambia: lessons for policy and practice. *BMC Health Serv Res.* 2013;13:97.
 133. Visser MJ, Neufeld S, De Villiers A, Makin JD, Forsyth BWC. To tell or not to tell: South African women's disclosure of HIV status during pregnancy. *AIDS Care - Psychological and Socio-Medical Aspects of AIDS/HIV.* 2008;20(9):1138-45.
 134. Kebaabetswe P, Ndase P, Mujugira A, Sekoto T, Ntshimane M, Owor A, et al. Perceptions of couple HIV counseling and testing in Botswana: a stakeholder analysis. *Patient Educ Couns.* 2010;79(1):120-3.
 135. Taegtmeier M, Kilonzo N, Mung'ala L, Morgan G, Theobald S. Using gender analysis to build voluntary counselling and testing responses in Kenya. *Trans R Soc Trop Med Hyg.* 2006;100(4):305-11.
 136. Kilewo C, Massawe A, Lyamuya E, Semali I, Kalokola F, Urassa E, et al. HIV counseling and testing of pregnant women in sub-Saharan Africa: experiences from a study on prevention of mother-to-child HIV-1 transmission in Dar es Salaam, Tanzania. *J Acquir Immune Defic Syndr.* 2001;28(5):458-62.
 137. Kipp W, Kabagambe G, Konde-Lule J. HIV counselling and testing in rural Uganda: communities' attitudes and perceptions towards an HIV counselling and testing programme. *AIDS Care.* 2002;14(5):699-706.
 138. MacPhail CL, Pettifor A, Coates T, Rees H. "You must do the test to know your status": attitudes to HIV voluntary counseling and testing for adolescents among South African youth and parents. *Health Educ Behav.* 2008;35(1):87-104.
 139. Tanzania National Bureau of Statistics. *National Accounts of Tanzania Mainland 2000-2010.* Dar es Salaam, Tanzania: 2011.
 140. Urassa M, Isingo R, Marston M, Kumugola Y, Mngara J, Chagalucha J, et al., editors. *Direct evidence of recent change in HIV prevalence and incidence in a rural population cohort in Northern Tanzania, 1994-2007.* XVIII International AIDS Conference; 2010; Vienna, Austria.

141. Gourlay A. Improving the usage of prevention of mother-to-child transmission of HIV services in rural Tanzania: University of London; 2014.
142. Mwaluko G, Urassa M, Isingo R, Zaba B, Boerma JT. Trends in HIV and sexual behaviour in a longitudinal study in a rural population in Tanzania, 1994-2000. *Aids*. 2003;17(18):2645-51.
143. United States Census Bureau. [03/04/2015]. Available from: <http://www.census.gov/population/international/software>.
144. Kabudula CW, Clark BD, Gomez-Olive FX, Tollman S, Menken J, Reniers G. The promise of record linkage for assessing the uptake of health services in resource constrained settings: a pilot study from South Africa. *BMC medical research methodology*. 2014;14:71.
145. Baisley K, Doyle AM, Chagalucha J, Maganja K, Watson-Jones D, Hayes R, et al. Uptake of voluntary counselling and testing among young people participating in an HIV prevention trial: comparison of opt-out and opt-in strategies. *PLoS ONE*. 2012;7(7):e42108.
146. Cawley C, Wringe A, Slaymaker E, Todd J, Michael D, Kumugola Y, et al. The impact of voluntary counselling and testing services on sexual behaviour change and HIV incidence: observations from a cohort study in rural Tanzania. *BMC infectious diseases*. 2014;14:159.
147. Cremin I, Alsallaq R, Dybul M, Piot P, Garnett G, Hallett TB. The new role of antiretrovirals in combination HIV prevention: a mathematical modelling analysis. *Aids*. 2013;27(3):447-58.
148. WHO. Global HIV/AIDS response: epidemic update and health sector progress towards universal access: progress report 2011 Geneva2011. Available from: http://www.who.int/hiv/pub/progress_report2011/en/index.html.
149. Lindgren TG, Deutsch K, Schell E, Bvumbwe A, Hart KB, Laviwa J, et al. Using mobile clinics to deliver HIV testing and other basic health services in rural Malawi. *Rural and remote health*. 2011;11(2):1682.
150. Boerma JT, Urassa M, Senkoro K, Klokke A, Ngweshemi JZ. Spread of HIV infection in a rural area of Tanzania. *Aids*. 1999;13(10):1233-40.
151. Li B, Quan H, Fong A, Lu M. Assessing record linkage between health care and Vital Statistics databases using deterministic methods. *BMC Health Serv Res*. 2006;6:48.
152. Cawley C, Wringe A, Isingo R, Mtenga B, Clark B, Marston M, et al. Low rates of repeat HIV testing despite increased availability of antiretroviral therapy in rural Tanzania: findings from 2003-2010. *PLoS ONE*. 2013;8(4):e62212.
153. Rosen S, Fox MP. Retention in HIV care between testing and treatment in sub-Saharan Africa: a systematic review. *PLoS Med*. 2011;8(7):e1001056.
154. De Cock KM, Marum E, Mbori-Ngacha D. A serostatus-based approach to HIV/AIDS prevention and care in Africa. *Lancet*. 2003;362(9398):1847-9.
155. Montaner JS, Hogg R, Wood E, Kerr T, Tyndall M, Levy AR, et al. The case for expanding access to highly active antiretroviral therapy to curb the growth of the HIV epidemic. *Lancet*. 2006;368(9534):531-6.
156. Velasco-Hernandez JX, Gershengorn HB, Blower SM. Could widespread use of combination antiretroviral therapy eradicate HIV epidemics? *Lancet Infect Dis*. 2002;2(8):487-93.
157. Kretzschmar ME, van der Loeff MF, Coutinho RA. Elimination of HIV by test and treat: a phantom of wishful thinking? *Aids*. 2012;26(2):247-8.
158. Bwambale FM, Ssali SN, Byaruhanga S, Kalyango JN, Karamagi CA. Voluntary HIV counselling and testing among men in rural western Uganda: implications for HIV prevention. *BMC Public Health*. 2008;8:263.
159. Hutchinson PL, Mahlalela X. Utilization of voluntary counseling and testing services in the Eastern Cape, South Africa. *AIDS Care*. 2006;18(5):446-55.

160. De Koker P, Lefevre P, Matthys F, van der Stuyft P, Delva W. Barriers to VCT despite 13 years of community-based awareness campaigns in a peri-urban township in northern Limpopo. *S Afr Med J*. 2010;100(6):364-5.
161. Kalichman SC, Simbayi LC. HIV testing attitudes, AIDS stigma, and voluntary HIV counselling and testing in a black township in Cape Town, South Africa. *Sex Transm Infect*. 2003;79(6):442-7.
162. Roura M, Wringe A, Busza J, Nhandi B, Mbata D, Zaba B, et al. "just like fever": A qualitative study on the impact of antiretroviral provision on the normalisation of HIV in rural Tanzania and its implications for prevention. *BMC International Health and Human Rights*. 2009;9(1).
163. Barnighausen T, Tanser F, Malaza A, Herbst K, Newell ML. HIV status and participation in HIV surveillance in the era of antiretroviral treatment: a study of linked population-based and clinical data in rural South Africa. *Trop Med Int Health*. 2012;17(8):e103-10.
164. Dare OO, Cleland JG. Reliability and validity of survey data on sexual behaviour. *Health transition review : the cultural, social, and behavioural determinants of health*. 1994;4 Suppl:93-110.
165. Slaymaker E. A critique of international indicators of sexual risk behaviour. *Sex Transm Infect*. 2004;80 Suppl 2:ii13-21.
166. Ferry B, Carael M, Buve A, Auvert B, Laourou M, Kanhonou L, et al. Comparison of key parameters of sexual behaviour in four African urban populations with different levels of HIV infection. *Aids*. 2001;15 Suppl 4:S41-50.
167. Boerma JT, Gregson S, Nyamukapa C, Urassa M. Understanding the uneven spread of HIV within Africa: comparative study of biologic, behavioral, and contextual factors in rural populations in Tanzania and Zimbabwe. *Sex Transm Dis*. 2003;30(10):779-87.
168. Buve A, Carael M, Hayes RJ, Auvert B, Ferry B, Robinson NJ, et al. The multicentre study on factors determining the differential spread of HIV in four African cities: summary and conclusions. *Aids*. 2001;15 Suppl 4:S127-31.
169. Cleland J, Boerma JT, Carael M, Weir SS. Monitoring sexual behaviour in general populations: a synthesis of lessons of the past decade. *Sex Transm Infect*. 2004;80 Suppl 2:ii1-7.
170. Wambura M, Urassa M, Isingo R, Ndege M, Marston M, Slaymaker E, et al. HIV prevalence and incidence in rural Tanzania: results from 10 years of follow-up in an open-cohort study. *J Acquir Immune Defic Syndr*. 2007;46(5):616-23.
171. Wringe A, Floyd S, Kazooba P, Mushati P, Baisley K, Urassa M, et al. Antiretroviral therapy uptake and coverage in four HIV community cohort studies in sub-Saharan Africa. *Trop Med Int Health*. 2012;17(8):e38-48.
172. Corbett EL, Makamure B, Cheung YB, Dauya E, Matambo R, Bandason T, et al. HIV incidence during a cluster-randomized trial of two strategies providing voluntary counselling and testing at the workplace, Zimbabwe. *Aids*. 2007;21(4):483-9.
173. Plummer ML, Wight D, Wamoyi J, Mshana G, Hayes RJ, Ross DA. Farming with your hoe in a sack: condom attitudes, access, and use in rural Tanzania. *Stud Fam Plann*. 2006;37(1):29-40.
174. Mwanga JR, Mshana G, Kaatano G, Chagalucha J. "Half plate of rice to a male casual sexual partner, full plate belongs to the husband": findings from a qualitative study on sexual behaviour in relation to HIV and AIDS in northern Tanzania. *BMC Public Health*. 2011;11:957.
175. International HIV/AIDS Alliance. Tools Together Now - 100 participatory tools to mobilise communities for HIV/AIDS 2006. Available from: www.aidsalliance.org.
176. de Negri B, Thomas E, Llinigumugabo A, Muvandi I, Lewis G. Empowering communities: participatory techniques for community-based programme development. Volume 1: Trainer's manual. Nairobi, Kenya 1998. Available from: <http://www.ponline.org/node/522852>.

177. Busza J, Zaba B, Urassa M. The "seeded" focus group: a strategy to recruit HIV+ community members into treatment research. *Sex Transm Infect.* 2009;85(3):212-5.
178. Pope C, Ziebland S, Mays N. Qualitative research in health care. Analysing qualitative data. *BMJ (Clinical research ed).* 2000;320(7227):114-6.
179. Nnko S, Boerma JT, Urassa M, Mwaluko G, Zaba B. Secretive females or swaggering males? An assessment of the quality of sexual partnership reporting in rural Tanzania. *Soc Sci Med.* 2004;59(2):299-310.
180. Musheke M, Ntalasha H, Gari S, McKenzie O, Bond V, Martin-Hilber A, et al. A systematic review of qualitative findings on factors enabling and deterring uptake of HIV testing in Sub-Saharan Africa. *BMC Public Health.* 2013;13:220.
181. Bunnell RE, Nassozi J, Marum E, Mubangizi J, Malamba S, Dillon B, et al. Living with discordance: knowledge, challenges, and prevention strategies of HIV-discordant couples in Uganda. *AIDS Care.* 2005;17(8):999-1012.
182. Ministry of Health and Social Welfare. HIV and AIDS Voluntary Counselling and Testing Module 3: Counselling Theories, Approaches and Techniques. Dar es Salaam, Tanzania: National AIDS Control Programme, 2008.
183. Wight D, Plummer ML, Mshana G, Wamoyi J, Shigongo ZS, Ross DA. Contradictory sexual norms and expectations for young people in rural Northern Tanzania. *Soc Sci Med.* 2006;62(4):987-97.
184. Wamoyi J, Fenwick A, Urassa M, Zaba B, Stones W. "Women's bodies are shops": beliefs about transactional sex and implications for understanding gender power and HIV prevention in Tanzania. *Arch Sex Behav.* 2011;40(1):5-15.
185. Lees S. Emergent HIV technology: urban Tanzanian women's narratives of medical research, microbicides and sexuality. *Cult Health Sex.* 2015;17(4):412-27.
186. Rasmussen LM. Counselling clients to follow 'the rules' of safe sex and ARV treatment. *Cult Health Sex.* 2013;15 Suppl 4:S537-52.
187. van Rooyen H, Durrheim K, Lindegger G. Advice-giving difficulties in voluntary counselling and testing: a distinctly moral activity. *AIDS Care.* 2011;23(3):281-6.
188. Clayden P. WHO 2013 guidelines: what about the missing formulations? 2013 [08/04/2015]. Available from: <http://www.thebodypro.com/content/72353/who-2013-guidelines-what-about-the-missing-formula.html>.
189. WHO. Statement on HIV testing and counseling: WHO, UNAIDS re-affirm opposition to mandatory HIV testing 2012 [08/04/2015]. Available from: http://www.who.int/hiv/events/2012/world_aids_day/hiv_testing_counselling/en/.
190. Ferguson L, Grant AD, Watson-Jones D, Kahawita T, Ong'ech JO, Ross DA. Linking women who test HIV-positive in pregnancy-related services to long-term HIV care and treatment services: a systematic review. *Trop Med Int Health.* 2012;17(5):564-80.
191. Genberg BL, Hlavka Z, Konda KA, Maman S, Chariyalertsak S, Chingono A, et al. A comparison of HIV/AIDS-related stigma in four countries: negative attitudes and perceived acts of discrimination towards people living with HIV/AIDS. *Soc Sci Med.* 2009;68(12):2279-87.
192. WHO. Delivering HIV test results and messages for re-testing and counselling in adults. Geneva, Switzerland: 2010.
193. Siu GE, Wight D, Seeley JA. Masculinity, social context and HIV testing: an ethnographic study of men in Busia district, rural eastern Uganda. *BMC Public Health.* 2014;14:33.
194. Krumeich A, Weijts W, Reddy P, Meijer-Weitz A. The benefits of anthropological approaches for health promotion research and practice. *Health Educ Res.* 2001;16(2):121-30.
195. WHO. Guidance on couples HIV testing and counselling including antiretroviral therapy for treatment and prevention in serodiscordant couples: recommendations for a public health approach. Geneva, Switzerland: 2012.

196. Becker S, Mlay R, Schwandt HM, Lyamuya E. Comparing couples' and individual voluntary counseling and testing for HIV at antenatal clinics in Tanzania: a randomized trial. *Aids Behav.* 2010;14(3):558-66.
197. Ross DA. Behavioural interventions to reduce HIV risk: what works? *Aids.* 2010;24 Suppl 4:S4-14.
198. Wanyenze RK, Kanya MR, Fatch R, Mayanja-Kizza H, Baveewo S, Szekeres G, et al. Abbreviated HIV counselling and testing and enhanced referral to care in Uganda: a factorial randomised controlled trial. *Lancet Glob Health.* 2013;1(3):e137-45.
199. Gupta GR, Parkhurst JO, Ogden JA, Aggleton P, Mahal A. Structural approaches to HIV prevention. *Lancet.* 2008;372(9640):764-75.
200. Abdool Karim Q, Abdool Karim SS, Frohlich JA, Grobler AC, Baxter C, Mansoor LE, et al. Effectiveness and safety of tenofovir gel, an antiretroviral microbicide, for the prevention of HIV infection in women. *Science.* 2010;329(5996):1168-74.
201. Thigpen MC, Kebaabetswe PM, Paxton LA, Smith DK, Rose CE, Segolodi TM, et al. Antiretroviral preexposure prophylaxis for heterosexual HIV transmission in Botswana. *The New England journal of medicine.* 2012;367(5):423-34.
202. Deeks JJ, Dinnes J, D'Amico R, Sowden AJ, Sakarovich C, Song F, et al. Evaluating non-randomised intervention studies. *Health Technol Assess.* 2003;7(27):iii-x, 1-173.
203. Crampin AC, Glynn JR, Ngwira BM, Mwaungulu FD, Ponnighaus JM, Warndorff DK, et al. Trends and measurement of HIV prevalence in northern Malawi. *Aids.* 2003;17(12):1817-25.
204. Obare F. Nonresponse in repeat population-based voluntary counseling and testing for HIV in rural Malawi. *Demography.* 2010;47(3):651-65.
205. Floyd S, Molesworth A, Dube A, Crampin AC, Houben R, Chihana M, et al. Underestimation of HIV prevalence in surveys when some people already know their status, and ways to reduce the bias. *Aids.* 2013;27(2):233-42.
206. Wringe A, Cremin I, Todd J, McGrath N, Kasamba I, Herbst K, et al. Comparative assessment of the quality of age-at-event reporting in three HIV cohort studies in sub-Saharan Africa. *Sex Transm Infect.* 2009;85 Suppl 1:i56-63.
207. Cremin I, Mushati P, Hallett T, Mupambireyi Z, Nyamukapa C, Garnett GP, et al. Measuring trends in age at first sex and age at marriage in Manicaland, Zimbabwe. *Sex Transm Infect.* 2009;85 Suppl 1:i34-40.
208. Gregson S, Mushati P, White PJ, Mlilo M, Mundandi C, Nyamukapa C. Informal confidential voting interview methods and temporal changes in reported sexual risk behaviour for HIV transmission in sub-Saharan Africa. *Sex Transm Infect.* 2004;80 Suppl 2:ii36-42.
209. Knerr W, Philpott A. Strange bedfellows: bridging the worlds of academia, public health and the sex industry to improve sexual health outcomes. *Health Res Policy Syst.* 2011;9 Suppl 1:S13.
210. Grabbe KL, Bunnell R. Reframing HIV prevention in sub-Saharan Africa using couple-centered approaches. *JAMA.* 2010;304(3):346-7.
211. Rosenberg NE, Pettifor AE, Bruyn GD, Westreich D, Delany-Moretlwe S, Behets F, et al. HIV Testing and Counseling Leads to Immediate Consistent Condom Use Among South African Stable HIV-Discordant Couples. *J Acquir Immune Defic Syndr.* 2013;62(2):226-33.
212. Mavhandu-Mudzusi AH, Netshandama VO, Davhana-Maselesele M. Nurses' experiences of delivering voluntary counseling and testing services for people with HIV/AIDS in the Vhembe District, Limpopo Province, South Africa. *Nurs Health Sci.* 2007;9(4):254-62.
213. UNAIDS. HIV This Month 2014 [08/04/2015]. Available from: <http://scienconow.unaids.org/articlelist/730>.

214. South A, Wringe A, Kumogola Y, Isingo R, Manyalla R, Cawley C, et al. Do accurate HIV and antiretroviral therapy knowledge, and previous testing experiences increase the uptake of HIV voluntary counselling and testing? Results from a cohort study in rural Tanzania. *BMC Public Health*. 2013;13:802.
215. Gourlay A, Wringe A, Todd J, Cawley C, Michael D, Machemba R, et al. Uptake of services for prevention of mother-to-child transmission of HIV in a community cohort in rural Tanzania from 2005 to 2012. *BMC Public Health*. 2015;Under review.
216. Gourlay A, Wringe A, Todd J, Cawley C, Michael D, Machemba R, et al. Factors associated with uptake of services to prevent mother-to-child transmission of HIV in a community cohort in rural Tanzania *Sex Transm Infect*. 2015;In press.

11 Appendices

11.1 Ethical clearance certificates

- 11.1.1 Kisesa cohort study activities**
- 11.1.2 Clinic-cohort data linkage project**
- 11.1.3 Qualitative study**

11.2 Data collection tools

- 11.2.1 Household enumeration form: DSS 28**
- 11.2.2 Sero-survey questionnaire (Sero6)**
- 11.2.3 TAZAMA WI-HTC (VCT) clinic main registration book**
- 11.2.4 TAZAMA WI-HTC (VCT) clinic client ID card**
- 11.2.5 TAZAMA WI-HTC (VCT) clinic test results book**
- 11.2.6 Protocol for PLA activities**
- 11.2.7 IDI discussion guide with users of HTC services**
- 11.2.8 IDI discussion guide with VCT counsellors**
- 11.2.9 IDI discussion guide with healthcare workers offering PITC**
- 11.2.10 IDI discussion guide with HTC trainer**

11.3 Parameters for the linkage algorithm

11.4 Evidence of retention of copyright

- 11.4.1 PLOS ONE**
- 11.4.2 BMC Infectious Diseases**



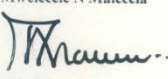

11.5 Conference presentations and posters

- 11.5.1 ICASA 2011 presentation slides**
- 11.5.2 ICASA 2011 poster presentation**
- 11.5.3 HIV/AIDS Interdisciplinary Perspectives conference slides**
- 11.5.4 IAS 2015 abstract**

11.1 Ethical clearance certificates

11.1.1 Kisesa cohort study activities

Tanzanian approval

	THE UNITED REPUBLIC OF TANZANIA	
National Institute for Medical Research P.O. Box 9653 Dar es Salaam Tel: 255 22 2121400/390 Fax: 255 22 2121380/2121360 E-mail: headquarters@nimr.or.tz NIMR/HQ/R.8a/Vol. IX/1489		Ministry of Health and Social Welfare P.O. Box 9083 Dar es Salaam Tel: 255 22 2120262-7 Fax: 255 22 2110986
Mr. Mark S. Urassa NIMR- Mwanza P. O. Box 1462 MWANZA TANZANIA		04 th March, 2013
CLEARANCE CERTIFICATE FOR CONDUCTING MEDICAL RESEARCH IN TANZANIA		
<p>This is to certify that the research entitled: Monitoring HIV prevalence and incidence in an observational HIV cohort in Magu District, Mwanza region (Urassa M. S. <i>et al</i>), has been granted ethical clearance to be conducted in Mwanza, Tanzania.</p> <p>The Principal Investigator of the study must ensure that the following conditions are fulfilled:</p> <ol style="list-style-type: none">1. Progress report is submitted to the Ministry of Health and the National Institute for Medical Research, Regional and District Medical Officers after every six months.2. Permission to publish the results is obtained from National Institute for Medical Research.3. Copies of final publications are made available to the Ministry of Health & Social Welfare and the National Institute for Medical Research.4. Any researcher, who contravenes or fails to comply with these conditions, shall be guilty of an offence and shall be liable on conviction to a fine. NIMR Act No. 23 of 1979, PART III Section 10(2).5. Approval is for one year: 04th March, 2013 to 03th March, 2014.		
Name: Dr Mwelecele N Malecela  Signature CHAIRPERSON MEDICAL RESEARCH COORDINATING COMMITTEE		Name: Dr Donan Mmbando  Signature ACTING CHIEF MEDICAL OFFICER MINISTRY OF HEALTH, SOCIAL WELFARE
CC: RMO DMO		

LSHTM approval

London School of Hygiene & Tropical Medicine
Keppel Street, London WC1E 7HT
United Kingdom
Switchboard: +44 (0)20 7636 8636
www.lshtm.ac.uk



Observational / Interventions Research Ethics Committee

Jim Todd
DPH / EPH
LSHTM

21 January 2014

Dear Mr. Todd,

Study Title: Analysis of the Sero 7 data from Kisesa Open HIV cohort

LSHTM ethics ref: 7191

Thank you for your application of 7 January 2014 for the above research, which has now been considered by the Observational Committee.

Confirmation of ethical opinion

On behalf of the Committee, I am pleased to confirm a favourable ethical opinion for the above research on the basis described in the application form, protocol and supporting documentation, subject to the conditions specified below.

Conditions of the favourable opinion

Approval is dependent on local ethical approval having been received, where relevant.

Approved documents

The final list of documents reviewed and approved by the Committee is as follows:

Document Type	File Name	Date	Version
Protocol / Proposal	Final2.zip	7/1/2014	1

After ethical review

Any subsequent changes to the application must be submitted to the Committee via an Amendment form on the online application website. All studies are also required to notify the ethics committee of any serious adverse events which occur during the project via an AdverseEvent form on the online application website. At the end of the study, please notify the committee via an End of Study form on the online application website.

Yours sincerely,

A handwritten signature in black ink, appearing to read "John Porter".

Professor John DH Porter
Chair

ethics@lshtm.ac.uk
<http://www.lshtm.ac.uk/ethics/>

Improving health worldwide

11.1.2 Clinic-cohort data linkage project

Tanzanian approval (original application)



THE UNITED REPUBLIC OF
TANZANIA



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NIMR/HQ/R.8a/Vol. IX/1304

Ministry of Health and Social Welfare
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Tel: 255 22 2120262-7
Fax: 255 22 2110986

08th March 2012

Dr Alison Wringe
London School of Hygiene and Tropical Medicine
Keppel Street, London WC1E 7HT, UK
C/O Mark S Urassa
NIMR Mwanza
P O Box 1462,
MWANZA

CLEARANCE CERTIFICATE FOR CONDUCTING MEDICAL RESEARCH IN TANZANIA

This is to certify that the research entitled: Monitoring access to HIV Voluntary Counseling and Testing (VCT) and HIV Care and Treatment Clinic (CTC) services in Kisesa, Magu district, Tanzania (Wringe A *et al*), whose Local Investigator is Mr Mark Urassa, NIMR Mwanza, has been granted ethics clearance to be conducted in Tanzania.

The Principal Investigator of the study must ensure that the following conditions are fulfilled:

1. Progress report is submitted to the Ministry of Health and the National Institute for Medical Research, Regional and District Medical Officers after every six months.
2. Permission to publish the results is obtained from National Institute for Medical Research.
3. Copies of final publications are made available to the Ministry of Health & Social Welfare and the National Institute for Medical Research.
4. Any researcher, who contravenes or fails to comply with these conditions, shall be guilty of an offence and shall be liable on conviction to a fine. NIMR Act No. 23 of 1979, PART III Section 10(2).
5. Approval is for one year: 08th March 2012 to 07th March 2013.

Name: Dr Mwelecele N Malecela

Name: Dr Donan Mmbando

Signature

Signature

CHAIRPERSON
MEDICAL RESEARCH
COORDINATING COMMITTEE

ACTING CHIEF MEDICAL OFFICER
MINISTRY OF HEALTH, SOCIAL
WELFARE

CC: RMO
DMO

LSHTM approval (original application)

**LONDON SCHOOL OF HYGIENE
& TROPICAL MEDICINE**

ETHICS COMMITTEE



APPROVAL FORM

Application number: A205 5567

Name of Principal Investigator **Alison Wringe**

Faculty **Epidemiology and Population Health**

Head of Faculty **Professor Laura Rodrigues**

Title: Extension of work in the study on Monitoring the uptake of HIV voluntary counselling and testing (VCT) in Tanzania.

Amendments to this application have been approved by the Ethics Committee.

Chair of the Committee

Date 1 October 2010

Approval is dependent on local ethical approval having been received.

Any subsequent changes to the application must be re-submitted to the Committee.

Tanzanian approval (amendment to original application)



THE UNITED REPUBLIC OF
TANZANIA



National Institute for Medical Research
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NIMR/HQ/R.8c/Vol. I/ 307

Ministry of Health and Social Welfare
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15th April 2014

Mr Mark Urassa
NIMR Mwanza
P O Box 1462
MWANZA

APPROVAL FOR PROTOCOL AMENDMENT

This letter is to confirm that your application for Amendment 01 on the study entitled: Monitoring Access to HIV voluntary Counseling and Testing (VCT) and HIV Care and Treatment Clinic Services in Kisesa, Magu Mwanza, Tanzania. Ref. NIMR/HQ/R.8a/Vol. IX/356, dated 15 December 2009, has been granted ethics clearance to be conducted in Tanzania

The Principal Investigator of the study must ensure that the approval is for the following amendments:

1. To add a PHD student Anabelle Gourlay, at the London School of Hygiene and Tropical Medicine, To work with Data Managers in Organizing Collection of the PMTCT Registers from the Clinics, advice on Data Edit Checks, work on Validation of the Linked datasets, and lead the PMTCT and ART linked Data Analysis
2. To link the Kisesa Clinic and Cohort Datasets to include a development Phase in which Data Management Team and researchers will optimize the algorithms used to carry out the linkage

Other condition for approval is as per original approval.
Approval is up to 15th December 2014

Name: Dr Mwelecele Malecela

Name: Dr Donan Mmbando

Signature
CHAIRPERSON
RESEARCH
COORDINATING COMMITTEE

Signature
CHIEF MEDICAL OFFICER MEDICAL
MINISTRY OF HEALTH & SOCIAL WELFARE

LSHTM approval (amendment to original application)

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Observational / Interventions Research Ethics Committee

Basia Zaba
DPH / EPH
LSHTM

6 January 2014

Dear Professor Zaba,

Study Title: Monitoring the uptake of HIV voluntary counselling and testing (VCT) in Tanzania
LSHTM ethics ref: 5567
LSHTM amend no: A483

Thank you for your application of 4 December 2013 for the amendment above to the existing ethically approved study and submitting revised documentation. The amendment application has been considered by the Observational Committee.

Confirmation of ethical opinion

On behalf of the Committee, I am pleased to confirm a favourable ethical opinion for the above amendment to research on the basis described in the application form, protocol and supporting documentation as revised, subject to the conditions specified below.

Conditions of the favourable opinion

Approval is dependent on local ethical approval for the amendment having been received, where relevant.

Approved documents

The final list of documents reviewed and approved by the Committee is as follows:

Document	Version	Date
LSHTM amendment application	n/a	02/12/2013

After ethical review

Any further changes to the application must be submitted to the Committee via an Amendment form on the online application website. The Principal Investigator is reminded that all studies are also required to notify the ethics committee of any serious adverse events which occur during the project via an Adverse Event form on the online application website. At the end of the study, please notify the committee via an End of Study form on the online application website.

Yours sincerely,

A handwritten signature in black ink, appearing to be 'John Porter'.

Professor John DH Porter
Chair
ethics@lshtm.ac.uk
<http://www.lshtm.ac.uk/ethics/>

11.1.3 Qualitative study

Tanzanian approval



THE UNITED REPUBLIC OF
TANZANIA



National Institute for Medical Research
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Ministry of Health and Social Welfare
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Tel: 255 22 2120262-7
Fax: 255 22 2110986

08th March 2012

Dr Caoimhe Cawley
London School of Hygiene and Tropical Medicine
Keppel Street, London WC1E 7HT, UK
C/O Mark S Urassa
NIMR Mwanza
P O Box 1462,
MWANZA

CLEARANCE CERTIFICATE FOR CONDUCTING MEDICAL RESEARCH IN TANZANIA

This is to certify that the research entitled: A qualitative study to explore the role of HIV Counseling and Testing services in HIV prevention in Kisesa, Magu District, Tanzania (Cawley C *et al*), whose Local Investigator is Mr Mark Urassa, NIMR Mwanza, has been granted ethics clearance to be conducted in Tanzania.

The Principal Investigator of the study must ensure that the following conditions are fulfilled:

1. Progress report is submitted to the Ministry of Health and the National Institute for Medical Research, Regional and District Medical Officers after every six months.
2. Permission to publish the results is obtained from National Institute for Medical Research.
3. Copies of final publications are made available to the Ministry of Health & Social Welfare and the National Institute for Medical Research.
4. Any researcher, who contravenes or fails to comply with these conditions, shall be guilty of an offence and shall be liable on conviction to a fine. NIMR Act No. 23 of 1979, PART III Section 10(2).
5. Approval is for one year: 08th March 2012 to 07th March 2013.

Name: Dr Mwelecele N Malecela

Signature

CHAIRPERSON
MEDICAL RESEARCH
COORDINATING COMMITTEE

CC: RMO
DMO

Name: Dr Donan Mmbando

Signature

ACTING CHIEF MEDICAL OFFICER
MINISTRY OF HEALTH, SOCIAL
WELFARE

LSHTM approval

**LONDON SCHOOL OF HYGIENE
& TROPICAL MEDICINE**

ETHICS COMMITTEE



APPROVAL FORM

Application number: 6036

Name of Principal Investigator **Caoimhe Cawley**

Faculty **Epidemiology and Population Health**

Head of Faculty **Professor Laura Rodrigues**

Title: A qualitative study to explore the role of HIV counselling and testing services in HIV prevention in Kisesa, Tanzania

This application is approved by the Committee.

Chair of the Ethics Committee

Date22 September 2011

Approval is dependent on local ethical approval having been received.

Any subsequent changes to the application must be submitted to the Committee via an E2 amendment form.

11.2 Data collection tools

11.2.1 Household enumeration form: DSS 28

TAZAMA Project, NIMR Mwanza
Demographic follow-up for existing members

Household Enumeration Form: DSS28 GPS Statu **Y** Take Picture **A**

Kijiji **Kitongoji Balozi Kaya** Interviewer Code **01 01 001** Date of Previous Interview **06-09-2011** Interview Start Date **06-09-2011**

Head of Household Line Number **01** Line Number of Respondent **01** Entire Household Move ☐ Date Of Move **06/09/2011** Reason for Move **01** Where Moved to **01** Observation Code **01** Interview End Date **06/09/2011**

Check if information from earlier rounds is correct				Children 0-17				All	Dead	All	Members who left				All	Adults 15+				Women 15-49		Youth 5-25	Line Number					
Line Number	First Name	Second Name	Sex	Birth Year	Last Round Status	Current Status	Picture Status	Mother Line Number	Mother Status	Father Line Number	Father Status	Still Alive?	Death Date MM / YYYY	Still live here?	Move Date MM / YYYY	Where moved to?	Move Reason?	Slept Here last Night?	Marital Status	Spouse Line Number	Where is the Spouse?	Second wife Line Number	Where is the Second Wife?	Pregnant Now?	Did She give Birth Last DSS?	Still At School?	School type and Year?	
1			M	1955	I	N																						1
2			F	1965	I	Y																		N				2
3			M	1986	I	Y																						3
4			M	1988	I	N																						4
5			M	1990	I	N																						5
6			M	1992	I	N																						6
7			F	1994	H	N	2		1																			7
8			F	1996	I	N	2		1															N				8
9			M	1962	H	N																						9
10			F	1998	I	Y	2		1																			10
11			M	2001	I	N	2		1																			11
12			M	1994	H	N																						12
13			M	2006	I	Y	2		1																			13
14			F	1990	H	N																						14
15			F	2006	H	N	14		16																			15
16			M	1986	H	N																						16
17			F	1982	H	N																						17
18			F	1972	I	Y																		N				18
19			F	1992	I	Y																		LRP				19
20			M	2010	I	Y	19		3																			20

1 2 3 4 5A 7A 11 12 13 14 15 16 32A 33A 34A 35A 36 41 42 43 44 45 51 52 60 61 62

V01.1 3/19/2016 11:21

TAZAMA Project, NIMR Mwanza

Demographic details for new and returning members

Household Enumeration Form: DSS28

Kijiji Kitongoji Balozi Kaya
1 01 01 001

Check if information from earlier rounds is correct						All	Children 0-17				All	Dead	New or Returning Member			All	Adults 15+					Women 15-49	Youth 5-25			
Line Number	First Name	Second Name	Sex	Birth Date DD / MM / YYYY			Residency Type	Picture Status	Mother Line Number	Mother Status	Father Line Number	Father Status	Still Alive?	Death Date MM / YYYY	Resident Or Visitor?	Arrival Date MM / YYYY	Arrival Reason Arrived From ?	Slept here last Night?	Marital Status	Spouse Line Number	Where is the Second Wife? Number	Where is the Spouse?	Pregnant Now?	Did She give Birth Last DSS?	Still At School?	School Type and Year
1			M				N																			
2			F				Y																			
3			M				Y																			
4			M				N																			
5			M				N																			
6			M				N																			
7			F				N																			
8			F				N																			
9			M				N																			
10			F				Y																			
11			M				N																			
12			M				N																			
13			M				Y																			
14			F				N																			
15			F				N																			
16			M				N																			
17			F				N																			
18			F				Y																			
19			F				Y																			
20			M				Y																			

1	2	3	4	5A	7A	11	12	13	14	15	16	32A	33A	34A	35A	36	41	42	43	44	45	51	52	60	61	62
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VSI-1 3/19/2015 11:21

11.2.2 Sero-survey questionnaire (Sero6)

Registration and consent sheet**Sero6 link number****1234567**

Today's Date
 Day Month Year

Informed consent for general survey participation

		Please print names	staff ID code
r1	Name of person reading information sheet	<input type="text"/>
r2	Who will sign informed consent?	circle response Respondent 1 Witness 2	Respondent → ic1
r3	Name of witness for informed consent	<input type="text"/>

Read first side of information sheet down to first consent question, sign next to yes or no box:

ic1	Do you agree to register at the clinic and answer questions in our survey?	circle response Yes 1 No 2	Signature
------------	--	---	--------------------

If ic1 is NO stop here, attach all stickers to back of form so they cannot be used elsewhere.

Informed consent for HIV tests: sign to confirm yes or no response

ic2	Do you agree to provide us with a blood spot for our HIV research tests and for us to store the blood spot for further tests, without telling you the result?	circle response Yes 1 No 2	Signature
ic3	Do you want to have a VCT test for HIV so you can find out your HIV status today? If no, sign, fill r4 and then go to r11	circle response Yes 1 No 2	Signature
ic4	If yes, can we store the VCT blood sample to carry out further research tests in the future, for which you will not receive individual results?	circle response Yes 1 No 2	Signature

Which sections of the sero-survey clinic did the person visit?

	Section	Write your staff ID code below if this person visits your section	
r4	Identification desk	<input type="text"/>	
r5	Questionnaire hut	<input type="text"/>	r5a QC <input type="text"/>
r6	DBS research sample	<input type="text"/>	do not go here if ic2 is No
r7	Clinician consultation	<input type="text"/>	
r8	Laboratory diagnostics	<input type="text"/>	
r9	Drug dispensary	<input type="text"/>	
r10	VCT counsellor	<input type="text"/>	do not go here if ic3 is No

Identification form

r11	Ask: What name do you use now?									
r12	Ask: What name have you used before now (if different)?									
r13	Check: Was the person recognised by the village enumerator or other helper?	Yes 1 No 2	Yes - put staff code of helper No - put 0000	<table border="1"><tr><td> </td><td> </td><td> </td><td> </td><td> </td><td> </td><td> </td></tr></table>							
r14	Ask: Have you got a sero survey invitation slip?	Yes 1 No 2	no → r20								

Take their invitation slip so you can check the following

r15	Check: Does sex of person match sex on the invitation slip?	Yes 1 No 2								
r16	Check: Does age of person approximately match age on the invitation slip?	Yes 1 No 2								
r17	Copy the name written on the invitation slip								
r18	Think carefully Is the person using the correct invitation slip?	Yes 1 No 2	no → r20							
r19	Copy the DSS link number only from correct invitation slip	<table border="1"><tr><td> </td><td> </td><td> </td><td> </td><td> </td><td> </td><td> </td></tr></table>								→ r35

If invitation slip is correct put one of the sero6 linking stickers on it**If invitation slip is wrong put the slip in the wrong invitation box****Identify those with wrong invitation or no invitation by consulting clinic register**

	Current residence	name	DSS code							
r20	Village		<table border="1"><tr><td> </td></tr></table>							
r21	Subvillage		<table border="1"><tr><td> </td><td> </td></tr></table>							
r22	Balozi (if known)		<table border="1"><tr><td> </td><td> </td></tr></table>							
r23	Can you find this person in the clinic register?	Yes 1 No 2	no → r25							
r24	Copy down the DSS link number if it is in the register	<table border="1"><tr><td> </td><td> </td><td> </td><td> </td><td> </td><td> </td><td> </td></tr></table>								→ r35

Check if this person currently lives in a household that is in the clinic register

r25	Do you know the name of any other invited person from same household? Write NONE if no-one else invited	.....
r26	Was the household found in the clinic register?	Yes 1	No 2
r27	Write down the household DSS number	<div style="display: flex; justify-content: space-around;"> <div><div></div></div> <div><div></div><div></div></div> <div><div></div><div></div></div> <div><div></div><div></div></div> </div>	
r28	Fill new member DSS visit request form	<div style="display: flex; align-items: center;"> <div style="border-bottom: 1px solid black; width: 100px; margin-right: 10px;"></div> DSS visit request form no. </div>	
r29	Were you previously resident in a different household in Kisesa ward?	Yes 1	No 2

Consult clinic register for place of previous residence

	Previous residence	name	DSS code
r30	Village		<div style="border-bottom: 1px solid black; width: 20px;"></div>
r31	Subvillage		<div style="border-bottom: 1px solid black; width: 30px;"></div>
r32	Balozi (if known)		<div style="border-bottom: 1px solid black; width: 30px;"></div>
r33	Can you find the previous residence in the clinic register?	Yes 1	No 2
r34	Write down the DSS link number if shown for previous residence	<div style="display: flex; justify-content: space-around;"> <div><div></div></div> <div><div></div><div></div></div> <div><div></div><div></div></div> <div><div></div><div></div></div> </div>	

Check past sero-survey attendance for those with clinic register entry

r35	Is the person's old study number available from invitation slip or clinic register entry?	Yes 1	No 2
r36	Copy old study number from invitation slip or clinic register	<div style="display: flex; justify-content: space-around;"> <div><div></div></div> <div><div></div><div></div></div> <div><div></div><div></div></div> <div><div></div><div></div></div> </div>	
r37	Ask: Have you ever attended a sero survey before this one?	Yes 1	No 2

If person answers no, they have never been to sero-survey before, probe carefully and check that you have found the correct line in the clinic register.

Make any corrections necessary above in RED ink, remember to cross out incorrect study number on this form if there is no study number for this person in the register.

If past sero-survey number not available from invitation slip or clinic register entry

r38	Ask: Have you ever attended a sero survey before this one?	Yes 1	No 2	no → q1
r39	Ask: Were you old enough to be interviewed last time you came to a sero survey?	Yes 1	No 2	no → q1
r40	Ask: Were you resident in Kisesa last time you came to a sero survey?	Yes 1	No 2	no → q1

Consult clinic register for village of residence at latest sero-survey

	Residence at last sero survey attended	Name	DSS code
r41	Village		<div></div>
r42	Subvillage		<div></div>
r43	Balozi (if known)		<div></div>
r44	Check: Is the person's previous residence in the clinic register?	Yes 1No 2	no → q1
r45	Write down the DSS link number for previous residence if one is shown.	<div></div>	
r46	Is the old study number shown in clinic register?	Yes 1No 2	no → q1
r47	Copy old study number from clinic register	<div></div>	

Label page

This label for invitation slip	*123456789* 1234567
This label for DSS visit request form	*123456789* 1234567
This label for DBS submission form	*123456789* 1234567
This label for clinician diagnosis record	*123456789* 1234567
This label for pharmacy dispensing record	*123456789* 1234567
This label for VCT attendance record	*123456789* 1234567
This label for green VCT to CTC referral form	*123456789* 1234567
This label for plasma submission form	*123456789* 1234567
This is a spare label	*123456789* 1234567

Stickers supplied by NIMR lab

Put DBS lab sticker here	
Put plasma lab sticker here	
Sero Link Number	*123456789*

This blank page represents reverse side of label page

Main questionnaire

Note to interviewers: q1 to q5 filled at identification desk before going to interview hut

q1	Sex (circle one)	Male 1 Female 2	
q2	Date of birth (write 99 if day or month not known, 9999 if year not known)	<div> <div> <div></div> <div></div> </div> <div> <div></div> <div></div> </div> <div> <div></div> <div></div> <div></div> <div></div> </div> </div> <div>dd mm yyyy</div>	
q3	Age or approximate age (refer to calendar of events if needed)	<div> <div></div> <div></div> </div> <div>years</div>	
q4	Height	<div> <div></div> <div></div> <div></div> <div></div> </div> <div>cms</div>	
q5	Weight	<div> <div></div> <div></div> <div></div> <div></div> </div> <div>kgs</div>	

Private interview starts here**Education & literacy**

q6	Can you read? (circle one)	Yes 1 No 2	
q7	Can you write?	Yes 1 No 2	
q8	Have you had a formal education?	Yes 1 No 2	no → q10
q9	How many years of education did you have?	number of years completed at each level	
q9a	Primary	<div> <div></div> <div></div> </div> <div>years</div>	
q9b	Secondary	<div> <div></div> <div></div> </div> <div>years</div>	
q9c	College	<div> <div></div> <div></div> </div> <div>years</div>	
q9d	University	<div> <div></div> <div></div> </div> <div>years</div>	
q9e	Adult institute	<div> <div></div> <div></div> </div> <div>years</div>	
q9f	Religious education	<div> <div></div> <div></div> </div> <div>years</div>	
q9g	Other (specify below)	<div> <div></div> <div></div> </div> <div>years</div>	
q9h		.....

Economic activity

q10	Do you perform any work that helps you or your household earn money? <div> <div>Yes</div> <div>1</div> </div> <div> <div>No, I am still a student</div> <div>2</div> </div> <div> <div>No, I just look after the house</div> <div>3</div> </div> <div> <div>No, I am too ill to work</div> <div>4</div> </div> <div> <div>No, I am too old to work</div> <div>5</div> </div> <div> <div>No, other reason (specify below)</div> <div>6</div> </div>	Circle only one response <div> <div></div> <div></div> </div> <div>for all “No, ...” responses → q13</div>
q10a	

q11	What is the main way in which you earn money?	Circle only one response
	Farming	01
	Tending livestock	02
	Small business	03
	Large business	04
	Professional	05
	Driver	06
	Skilled manual worker	07
	Unskilled labourer	08
	Fishing	09
	Bar Work	10
	Other (specify below)	11
q11a		.....

q12	In which other ways do you earn money? <i>Do not read out the list below, but after each response ask if there are other ways</i>	Write 01 for the way mentioned first, 02 for the second, etc. When respondent runs out of answers write 00 in all unused lines
q12a	Farming	__ __
q12b	Tending livestock	__ __
q12c	Small business	__ __
q12d	Large business	__ __
q12e	Professional	__ __
q12f	Driver	__ __
q12g	Skilled manual worker	__ __
q12h	Unskilled labourer	__ __
q12i	Fishing	__ __
q12j	Bar Work	__ __
q12k	Other (specify below)	__ __
q12l		.....

Religion and Ethnicity

q13	What is your ethnic group?	Circle only one response
	Sukuma	1
	Other (specify below)	2
q13a		.....
q14	What is your religion?	Circle only one response
	Muslim	1
	Catholic	2
	Other established Christian	3
	Other evangelical Christian	4
	Traditional	5
	None	6
	Other (specify below)	7
q14a		.....

Residence and mobility

q15	Were you born in the village that you now live in?	Yes 1 No 2	yes → q19
q16	Have you lived in this same village for 1 year or more?	Yes 1 No 2	no → q16b
q16a	How many years have you lived in this village?	___ years	→ q17
q16b	How many months have you lived in this village?	___ months	
q17	Where did you live before moving here?	Circle only one response	
	Other part of Kisesa ward	1	
	Another part of Magu district	2	
	Mwanza city	3	
	Another part of Mwanza region	4	
	Another part of Tanzania	5	
	Another country	6	
q18	What type of place was it?	Circle only one response	
	Rural – remote	1	
	Rural – on main road	2	
	Urban	3	

Condom knowledge

q19	Have you ever heard of condoms?	Yes 1 No 2	no → q22
q20	Is it possible to get condoms in this village?	Yes 1 No 2 DK 9	no or DK → q22
q21	Where can you get condoms in this village? <i>Do not read out the list, but after each response ask if there are other places</i>	Write 1 for place mentioned first, 2 for the second, etc. If respondent doesn't know any, or any more places, write 0 in all unused lines	
q21a	Village dispensary	<input type="text"/>	
q21b	Family planning clinic	<input type="text"/>	
q21c	Pharmacy	<input type="text"/>	
q21d	Shop	<input type="text"/>	
q21e	Community distribution scheme	<input type="text"/>	
q21f	TANESA / TAZAMA / PSI	<input type="text"/>	
q21g	Other (specify below)	<input type="text"/>	
q21h		.....

Family planning

q22	Have you ever heard about family planning?	Yes 1 No 2	no → r29
q23	What was the source of your information? <i>Do not read out the list, but after each response ask if there were other sources</i>	Write 1 for source mentioned first, 2 for the second, etc. When respondent runs out of answers write 0 in all unused lines	
q23a	Radio	<input type="text"/>	
q23b	Television	<input type="text"/>	
q23c	Posters	<input type="text"/>	
q23d	Newspapers / Magazines	<input type="text"/>	
q23e	Health facility	<input type="text"/>	
q23f	TANESA / UMATI	<input type="text"/>	
q23g	Family member or friend	<input type="text"/>	
q23h	Other (specify below)	<input type="text"/>	
q23i		.....

q24	Have you ever used family planning ?	Yes 1	No 2	no → q28
q25	Which methods did you use? <i>Do not read out the list, but after each response ask if there were other methods</i>	Write 01 for method mentioned first, 02 for the second, etc. When respondent runs out of answers write 00 in all unused lines		
q25a	Pills	_____		
q25b	IUD/loop	_____		
q25c	Injection	_____		
q25d	Female condom or cap	_____		
q25e	Male condom	_____		
q25f	Female sterilisation	_____		
q25g	Male sterilisation / vasectomy	_____		
q25h	Norplant	_____		
q25i	Abstinence	_____		
q25j	Calendar / rhythm	_____		
q25k	Traditional methods	_____		
q25l	Other (specify below)	_____		
q25m		.....	

q26	Are you currently using family planning?	Yes 1	No 2	no → q28
q27	Which is the main method that you use now?	Circle only one response		
	Pills	01		
	IUD/loop	02		
	Injection	03		
	Female condom or cap	04		
	Male condom	05		
	Female sterilisation	06		
	Male sterilisation / vasectomy	07		
	Norplant	08		
	Abstinence	09		
	Calendar / rhythm	10		
	Traditional methods	11		
	Other (specify below)	12		
q27a		.....	
q28	Do you intend to use family planning in the future?	Yes 1	No 2	DK 9

Pregnancy and childbirth

q29	Check q1 and q3 : is this person a woman aged 15-49?	Yes 1	No 2	no → q42
------------	---	-------	------	----------

q30	Have you ever been pregnant?	Yes 1	No 2	no → q42
------------	------------------------------	-------	------	----------

q31	Have you ever given birth?	Yes 1	No 2	no → q37
------------	----------------------------	-------	------	----------

		write 00 if none in q32a to q32f	
q32	How many of your own biological children:	Boys	Girls
	live with you in your home?	q32a <input type="text"/> <input type="text"/>	q32b <input type="text"/> <input type="text"/>
	live somewhere else?	q32c <input type="text"/> <input type="text"/>	q32d <input type="text"/> <input type="text"/>
	have died?	q32e <input type="text"/> <input type="text"/>	q32f <input type="text"/> <input type="text"/>

Check: add together responses to q32a, q32b, q32c, q32d, q32e and q32f and enter at q33

q33	Say: I want to check, altogether you have given birth to <input type="text"/> <input type="text"/> children?
------------	--

If mother disagrees with your total estimate check responses to q32a, q32b, q32c, q32d, q32e and q32f and check your addition.

If total children = 01 → q35

q34	Do all your children have the same father?	Yes 1	No 2
q35	When did you last give birth? (write 99 if day or month not known, 9999 if year not known)	<input type="text"/> <input type="text"/> <input type="text"/> <input type="text"/> <input type="text"/> <input type="text"/> <input type="text"/> <input type="text"/> d d m m y y y y	
q36	Is your last born child still alive?	Yes 1	No 2
q37	Did you attend an Ante Natal Clinic (ANC) during your last pregnancy?	Yes 1	No 2 no → q39
q38	Which blood tests did you have at any ANC you attended during your last pregnancy?	Ask about each one in turn	
q38a	HIV test for PMTCT	Yes 1	No 2 DK 9
q38b	Syphilis test	Yes 1	No 2 DK 9
q38c	Test for anaemia	Yes 1	No 2 DK 9
q38d	Other blood test (specify below)	Yes 1	No 2
q38e		.....

q39	Are you pregnant now?	Yes 1	No 2	DK 9
q40	How many of your pregnancies have ended in a still birth? (write 99 if not known)	<input type="text"/> <input type="text"/> number		
q41	How many pregnancies have you had in which you lost a baby before it was fully formed? (write 99 if not known)	<input type="text"/> <input type="text"/> number		

Current marriage or cohabitation: men and women

q42	What is your current marital status? Never married or been in cohabiting union Monogamously married or cohabiting Polygamously married or cohabiting Widowed Separated or divorced	Circle only one response 1 never married → q51 2 3 4 5
q43	If polygamously married, how many co-wives are there in this marriage? (including person being interviewed, if woman)	<input type="text"/> number

First marriage or cohabitation

q44	How old were you when you first married or lived with a sexual partner? (write 99 if not known)	<input type="text"/> years old	
q45	Are you still married to or living with that same person?	Yes 1 No 2	if yes, → q51
q46	Is that first spouse / partner still alive?	Alive 1 Dead 2 DK 9	if alive or DK → q49
q47	Were you living together when he/she died?	Yes 1 No 2	
q48	Did he / she die in Kisesa ward?	Yes 1 No 2	→ q51
q49	Did you live together in Kisesa ward?	Yes 1 No 2	if no, → q51
q50	Does he / she still live in Kisesa ward?	Yes 1 No 2 DK 9	

First sex

q51	How old were you when you first had sex? (never = 99, don't know = 88, when married = 77)	<input type="text"/> years	if 99 → q57
q52	Why did you have sex at that time? I got married I wanted to have sex I was tricked into having sex I had sex because I needed money I was forced to have sex Can't remember, too long ago Other (specify below)	Circle only one response 1 2 3 4 5 6 7	
q52a		.....
q53	Did you use a condom when you first had sex? (if can't remember code don't know)	Yes 1 No 2 DK 9	

All sexual partners: *probe carefully and explain all partners must be reported, including spouses and partners who died long ago*

q54	How many different sexual partners altogether in your whole lifetime? (including spouse(s), regular & casual partners)	<input type="text"/>
q55	How many different sexual partners altogether in the last 12 months? (including spouse(s), regular & casual partners)	<input type="text"/> if 00 → q57

ALL SEXUAL PARTNERS IN LAST 12 MONTHS

		A) FIRST, MOST RECENT PARTNER		B) SECOND PARTNER		C) THIRD PARTNER	
pp1	How would you describe your relationship to this person? <i>Circle only one</i>	Spouse or cohabiting partner	1	Spouse or cohabiting partner	1	Spouse or cohabiting partner	1
		Regular partner	2	Regular partner	2	Regular partner	2
		Casual partner	3	Casual partner	3	Casual partner	3
		Other friend or visitor	4	Other friend or visitor	4	Other friend or visitor	4
pp2	Do you live in the same house as this partner?	Yes 1	No 2	yes → pp4		Yes 1	No 2
					yes → pp4		yes → pp4
pp3	Where does this partner live now? <i>Circle only one</i>	Other part of Kisesa ward	1	Other part of Kisesa ward	1	Other part of Kisesa ward	1
		Another part of Magu district	2	Another part of Magu district	2	Another part of Magu district	2
		Mwanza city	3	Mwanza city	3	Mwanza city	3
		Another part of Mwanza region	4	Another part of Mwanza region	4	Another part of Mwanza region	4
		Another part of Tanzania	5	Another part of Tanzania	5	Another part of Tanzania	5
		Another country	6	Another country	6	Another country	6
		Dead	7	Dead	7	Dead	7
		Don't know	8	Don't know	8	Don't know	8
pp4	Is this partner older or younger than you? <i>Circle only one</i>	more than 10 years older	1	more than 10 years older	1	more than 10 years older	1
		around 5 years older	2	around 5 years older	2	around 5 years older	2
		about same age	3	about same age	3	about same age	3
		around 5 years younger	4	around 5 years younger	4	around 5 years younger	4
		more than 10 years younger	5	more than 10 years younger	5	more than 10 years younger	5

Last sex with this partner

pp5	When did you last have sex with this partner? <i>One line each partner</i>	last week 1 →	How many times:	in last week? <input type="text"/>	last week 1 →	How many times:	in last week? <input type="text"/>	last week 1 →	How many times:	in last week? <input type="text"/>
		last month 2 →		in last month? <input type="text"/>	last month 2 →		in last month? <input type="text"/>	last month 2 →		in last month? <input type="text"/>
		last year 3 →		in last year? <input type="text"/>	last year 3 →		in last year? <input type="text"/>	last year 3 →		in last year? <input type="text"/>
pp6	Did you use a condom last time you had sex?	Yes 1	No 2		Yes 1	No 2		Yes 1	No 2	
pp7	Had either you or your partner drunk alcohol last time you had sex?	Yes 1	No 2		Yes 1	No 2		Yes 1	No 2	
pp8	Do you think in the future you will have sex with this partner again?	Yes 1	No 2		Yes 1	No 2		Yes 1	No 2	

Most recent partners continued

		A) FIRST, MOST RECENT PARTNER			B) SECOND PARTNER			C) THIRD PARTNER		
	Check: is this spouse or regular partner ?	→ pp10			→ pp10			→ pp10		
	Check: is pp5 how many times > 01 ?	→ pp10			→ pp10			→ pp10		
pp9	Was this the only time you ever had sex with this partner?	Yes 1	No 2	yes → pp13	Yes 1	No 2	yes → pp13	Yes 1	No 2	yes → pp13
pp10	How frequently did you use a condom with this partner? <i>Circle only one</i>	Always 1 Most of the time / often 2 Occasionally 3 Only at the start of the relationship 4 Never 5 Don't know 6			Always 1 Most of the time / often 2 Occasionally 3 Only at the start of the relationship 4 Never 5 Don't know 6			Always 1 Most of the time / often 2 Occasionally 3 Only at the start of the relationship 4 Never 5 Don't know 6		

First sex with this partner

pp11	When did you first have sex with this partner? <i>Circle only one</i>	last week 1 last month 2 last year 3 more than a year ago 4			last week 1 last month 2 last year 3 more than a year ago 4			last week 1 last month 2 last year 3 more than a year ago 4		
pp12	Did you use a condom first time you had sex with this partner?	Yes 1	No 2	DK 9	Yes 1	No 2	DK 9	Yes 1	No 2	DK 9
pp13	Before you first had sex with this partner how long had you known him/her? <i>Circle only one</i>	less than a week 1 less than a month 2 less than a year 3 more than a year 4			less than a week 1 less than a month 2 less than a year 3 more than a year 4			less than a week 1 less than a month 2 less than a year 3 more than a year 4		

Next partner

pp14	Did you have sex with anyone else in the last 12 months?	Yes 1	→ pp1 for second partner	Yes 1	→ pp1 for third partner	Yes 1	→ pp1 for fourth partner
		No 2	→ q56 end of partner columns	No 2	→ q56 end of partner columns	No 2	→ q56 end of partner columns

ALL SEXUAL PARTNERS IN LAST 12 MONTHS

		D) FOURTH PARTNER		E) FIFTH PARTNER		F) SIXTH PARTNER	
pp1	How would you describe your relationship to this person? <i>Circle only one</i>	Spouse or cohabiting partner	1	Spouse or cohabiting partner	1	Spouse or cohabiting partner	1
		Regular partner	2	Regular partner	2	Regular partner	2
		Casual partner	3	Casual partner	3	Casual partner	3
		Other friend or visitor	4	Other friend or visitor	4	Other friend or visitor	4
pp2	Do you live in the same house as this partner?	Yes 1 No 2	yes → pp4	Yes 1 No 2	yes → pp4	Yes 1 No 2	yes → pp4
pp3	Where does this partner live now? <i>Circle only one</i>	Other part of Kisesa ward	1	Other part of Kisesa ward	1	Other part of Kisesa ward	1
		Another part of Magu district	2	Another part of Magu district	2	Another part of Magu district	2
		Mwanza city	3	Mwanza city	3	Mwanza city	3
		Another part of Mwanza region	4	Another part of Mwanza region	4	Another part of Mwanza region	4
		Another part of Tanzania	5	Another part of Tanzania	5	Another part of Tanzania	5
		Another country	6	Another country	6	Another country	6
		Dead	7	Dead	7	Dead	7
		Don't know	8	Don't know	8	Don't know	8
pp4	Is this partner older or younger than you? <i>Circle only one</i>	more than 10 years older	1	more than 10 years older	1	more than 10 years older	1
		around 5 years older	2	around 5 years older	2	around 5 years older	2
		about same age	3	about same age	3	about same age	3
		around 5 years younger	4	around 5 years younger	4	around 5 years younger	4
		more than 10 years younger	5	more than 10 years younger	5	more than 10 years younger	5

Last sex with this partner

pp5	When did you last have sex with this partner? <i>One line each partner</i>	last week 1 →	How many times: in last week? <input type="text"/>	last week 1 →	How many times: in last week? <input type="text"/>	last week 1 →	How many times: in last week? <input type="text"/>
		last month 2 →	in last month? <input type="text"/>	last month 2 →	in last month? <input type="text"/>	last month 2 →	in last month? <input type="text"/>
		last year 3 →	in last year? <input type="text"/>	last year 3 →	in last year? <input type="text"/>	last year 3 →	in last year? <input type="text"/>
pp6	Did you use a condom last time you had sex?	Yes 1 No 2		Yes 1 No 2		Yes 1 No 2	
pp7	Had either you or your partner drunk alcohol last time you had sex?	Yes 1 No 2		Yes 1 No 2		Yes 1 No 2	
pp8	Do you think in the future you will have sex with this partner again?	Yes 1 No 2		Yes 1 No 2		Yes 1 No 2	

More distant partners continued

		D) FOURTH PARTNER			E) FIFTH PARTNER			F) SIXTH PARTNER		
	Check: is this spouse or regular partner ?	→ pp10			→ pp10			→ pp10		
	Check: is pp5 how many times > 01 ?	→ pp10			→ pp10			→ pp10		
pp9	Was this the only time you ever had sex with this partner?	Yes 1	No 2	yes → pp13	Yes 1	No 2	yes → pp13	Yes 1	No 2	yes → pp13
pp10	How frequently did you use a condom with this partner? <i>Circle only one</i>	Always 1 Most of the time / often 2 Occasionally 3 Only at the start of the relationship 4 Never 5 Don't know 6			Always 1 Most of the time / often 2 Occasionally 3 Only at the start of the relationship 4 Never 5 Don't know 6			Always 1 Most of the time / often 2 Occasionally 3 Only at the start of the relationship 4 Never 5 Don't know 6		

First sex with this partner

pp11	When did you first have sex with this partner? <i>Circle only one</i>	last week 1 last month 2 last year 3 more than a year ago 4			last week 1 last month 2 last year 3 more than a year ago 4			last week 1 last month 2 last year 3 more than a year ago 4		
pp12	Did you use a condom first time you had sex with this partner?	Yes 1	No 2	DK 9	Yes 1	No 2	DK 9	Yes 1	No 2	DK 9
pp13	Before you first had sex with this partner how long had you known him/her? <i>Circle only one</i>	less than a week 1 less than a month 2 less than a year 3 more than a year 4			less than a week 1 less than a month 2 less than a year 3 more than a year 4			less than a week 1 less than a month 2 less than a year 3 more than a year 4		

Next partner

pp14	Did you have sex with anyone else in the last 12 months?	Yes 1	→ pp1 for fifth partner	Yes 1	→ pp1 for sixth partner	Yes 1	→ q56 end of partner columns
		No 2	→ q56 end of partner columns	No 2	→ q56 end of partner columns	No 2	→ q56 end of partner columns

Check: Is the number of partner columns filled less than number of partners in last 12 months reported in q55 (or Less than 6 if q55 is 6 or more)?

If less, say: I just need to make sure, and repeat question pp14 on last partner column. If respondent remembers another partner in last 12 months continue with partner loops

Even if there is an inconsistency, do not ask respondent to change their answer to q55 partners in last 12 months, but report on consistency here (without asking respondent).

q56	Summary of partner reporting consistency: Number of columns agrees with partners last year Number of columns greater than partners last year Number of columns less than partners last year Number of columns less than partners last year because more than 6 partners last year	Circle only one response 1 2 3 4
------------	---	---

Partner loops finished → q58

If no sexual partners last 12 months

q57	Why did you abstain from sex in the last 12 months? No spouse or other sexual partner Previous spouse or partner died Quarrelled with spouse or partner Divorced from previous spouse Spouse / partner travelled away from home I travelled away from home Spouse / partner was too sick I was too sick We are abstaining after birth of a child Spouse /partner is afraid of HIV I am afraid of HIV Other (specify below)	Circle only one response 01 02 03 04 05 06 07 08 09 10 11 12
q57a		.....

Other risk factors

q58	Have you had a blood transfusion in the last 5 years?	Yes 1	No 2	
q59	How many injections did you get in last 12 months? (write 99 if not known)	___ number		
q60	Have you had body incisions during the last 5 years?	Yes 1	No 2	women → q63
q61	Have you been circumcised ?	Yes 1	No 2	no → q63
q62	How old were you when you were circumcised? (write 99 if not known)	___ years		

Knowledge of sexually transmitted infections

q63	Have you ever heard about sexually transmitted infections?	Yes 1	No 2	no → q65
q64	What are the signs of sexually transmitted infections? <i>Do not read out list, but after each response ask if there are other signs</i>	Write 1 for sign mentioned first, 2 for the second, etc. When respondent runs out of answers write 0 in all unused lines		
q64a	Discharge or bleeding from genitals	___		
q64b	Genital ulcers, swelling or irritation	___		
q64c	Difficulty in urinating	___		
q64d	Painful intercourse	___		
q64e	Pain in uterus	___		
q64f	Don't know any signs	___		
q64g	Other (specify below)	___		
q64h		.....	

Symptoms of sexually transmitted infections

q65	Have you had painful urination at any time in last 12 months?	Yes 1	No 2
q66	Have you urinated blood at any time in last 12 months?	Yes 1	No 2
q67	Have you had a genital discharge in last 12 months?	Yes 1	No 2
q68	Have you got genital ulcers or swelling in last 12 months?	Yes 1	No 2
	If q65 to q68 all answered No	→ q71	
q69	Do you still have any of these symptoms now?	Yes 1	No 2

q70	What action did you take? <i>Do not read out list, but after each response ask what else they did</i>	Write 1 for action mentioned first, 2 for the second, etc. When respondent runs out of answers write 0 in all unused lines
q70a	Treated at government health facility	<input type="text"/>
q70b	Treated at private health facility	<input type="text"/>
q70c	Self medication with pharmacy drugs	<input type="text"/>
q70d	Self medication with herbs	<input type="text"/>
q70e	Consulted traditional healer	<input type="text"/>
q70f	Got drugs from TANESA / TAZAMA / TUMAINI	<input type="text"/>
q70g	No action taken	<input type="text"/>
q70h	Other (specify below)	<input type="text"/>
q70i		.....

Knowledge about HIV

q71	Have you ever heard / read about HIV, the virus which causes AIDS?	Yes 1	No 2	no → q102
q72	What was the source of your information? <i>Do not read out list, but after each response ask if there were other sources</i>	Write 01 for source mentioned first, 02 for the second, etc. When respondent runs out of answers write 00 in all unused lines		
q72a	Radio	<input type="text"/>		
q72b	Television / Video / Cinema	<input type="text"/>		
q72c	Posters	<input type="text"/>		
q72d	Magazines / Booklets	<input type="text"/>		
q72e	Meetings / Campaigns (including TANESA)	<input type="text"/>		
q72f	At school / from peer counsellors	<input type="text"/>		
q72g	Church / Mosque	<input type="text"/>		
q72h	Health facility workers	<input type="text"/>		
q72i	Home based care / Village health worker	<input type="text"/>		
q72j	Family or friend	<input type="text"/>		
q72k	Other (specify below)	<input type="text"/>		
q72l		.....	

q73	Do you know how HIV/AIDS is transmitted?	Yes 1	No 2	no → q75
q74	Mention all the ways that you know <i>Do not read out list, but after each response ask if there are other ways</i>	Write 1 for way mentioned first, 2 for the second, etc. When respondent runs out of answers write 0 in all unused lines		
q74a	Having sex with a casual / high risk partner	<input type="text"/>		
q74b	Having sex without a condom	<input type="text"/>		
q74c	Unsafe blood transfusion	<input type="text"/>		
q74d	Unsterile injections	<input type="text"/>		
q74e	Mother to child transmission	<input type="text"/>		
q74f	Incisions on the body	<input type="text"/>		
q74g	Sharing personal items	<input type="text"/>		
q74h	Other (specify below)	<input type="text"/>		
q74i		.....	

q75	Is it possible for a healthy looking person to have HIV/AIDS?	Yes 1	No 2	DK 9
q76	Can AIDS be transmitted by mosquito bites?	Yes 1	No 2	DK 9
q77	Can AIDS be transmitted by sharing cups and plates?	Yes 1	No 2	DK 9
q78	Can AIDS be transmitted by kissing?	Yes 1	No 2	DK 9

Stigma and personal experience of HIV

q79	Where does HIV transmission mainly take place? <i>Do not read out list, but after each response ask if there are other places</i>	Write 1 for place mentioned first, 2 for the second, etc. If respondent doesn't know any or any more write 0 in all unused lines
q79a	Wedding and funeral parties	<input type="text"/>
q79b	Pombe shops	<input type="text"/>
q79c	Bars and guest houses	<input type="text"/>
q79d	Discos / Ngoma dances	<input type="text"/>
q79e	At hospitals	<input type="text"/>
q79f	At markets	<input type="text"/>
q79g	Hair salons	<input type="text"/>
q79h	Other (specify below)	<input type="text"/>
q79i		.....

q80	What kinds of people are responsible for transmitting HIV? <i>Do not read out list, but after each response ask if there are others</i>	Write 01 for people mentioned first, 02 for the second, etc. If respondent doesn't know any or any more, write 00 in all unused lines
q80a	Bar workers / Food vendors	<input type="text"/>
q80b	Students / Young people	<input type="text"/>
q80c	People who travel a lot	<input type="text"/>
q80d	Widows and widowers	<input type="text"/>
q80e	Refugees and homeless people	<input type="text"/>
q80f	Drunks &/or drug users	<input type="text"/>
q80g	Teachers and village leaders	<input type="text"/>
q80h	Health workers and hospital workers	<input type="text"/>
q80i	Homosexuals	<input type="text"/>
q80j	Anyone can transmit it	<input type="text"/>
q80k	Other (specify below)	<input type="text"/>
q80l		.....

q81	Among your relatives is anyone infected with HIV?	Yes 1	No 2	DK 9
q82	Have any of your relatives died of AIDS?	Yes 1	No 2	DK 9
q83	Is anyone in this village infected with HIV?	Yes 1	No 2	DK 9
q84	Has anyone in this village died of AIDS?	Yes 1	No 2	DK 9

Need for services

q85	What services are needed to help HIV infected people? <i>Do not read out list, but after each response ask if there are others</i>	Write 1 for those mentioned first, 2 for the second, etc. If respondent doesn't know any or any more write 0 in all unused lines
q85a	Drugs to treat HIV	<input type="text"/>
q85b	Drugs to treat other infections	<input type="text"/>
q85c	Home based care during serious illness	<input type="text"/>
q85d	Help to get food	<input type="text"/>
q85e	Help to take care of their children	<input type="text"/>
q85f	Other (specify below)	<input type="text"/>
q85g		.....

q86	What services are needed to prevent new HIV infections? <i>Do not read out list, but after each response ask if there are others</i>	Write 1 for those mentioned first, 2 for the second, etc. If respondent doesn't know any or any more, write 0 in all unused lines
q86a	Education & information	<input type="text"/>
q86b	Condom provision	<input type="text"/>
q86c	Rules to enforce good behaviour	<input type="text"/>
q86d	PMTCT in ANC clinics	<input type="text"/>
q86e	Clean syringes at health centres & dispensaries	<input type="text"/>
q86f	Other (specify below)	<input type="text"/>
q86g		.....

Experience of VCT

q87	Have you ever had VCT ?	Yes 1	No 2	no → q99
q88	When did you last use any of these VCT services?	Ask about each		
q88a	Sero survey VCT note: sero5 was in 2006	At sero5 1	At earlier sero-survey 2	Never 3
q88b	Kisesa health centre VCT	Last year 1	More than a year ago 2	Never 3
q88c	ANGAZA	Last year 1	More than a year ago 2	Never 3
q88d	At ANC clinic	Last year 1	More than a year ago 2	Never 3
q88e	Mobile VCT service	Last year 1	More than a year ago 2	Never 3
q88f	Other (specify below)	Last year 1	More than a year ago 2	Never 3
q88g		.....	

q89	Did you receive pre-test counselling at your last VCT?	Yes 1	No 2
q90	Did you find out your test results after your last VCT?	Yes 1	No 2
q91	Did you receive post-test counselling after your last VCT?	Yes 1	No 2

q92	Did you tell anyone about your test result?	Yes 1	No 2	no → q94
q93	Who did you tell? <i>Do not read out list, but after each response ask if there were other people</i>	Write 1 for person mentioned first, 2 for the second, etc. When respondent runs out of answers write 0 in all unused lines		
q93a	Spouse / partner	<input type="checkbox"/>		
q93b	Parent	<input type="checkbox"/>		
q93c	Other relative	<input type="checkbox"/>		
q93d	Friend	<input type="checkbox"/>		
q93e	Home Based Care Worker	<input type="checkbox"/>		
q93f	Other (specify below)	<input type="checkbox"/>		
q93g		.....	

q94	Would you recommend a friend to have VCT?	Yes 1	No 2	DK 9
q95	Was your VCT counsellor kind and understanding?	Yes 1	No 2	
q96	Was the VCT interview embarrassing or difficult?	Yes 1	No 2	
q97	Can VCT counsellors be trusted to keep results secret?	Yes 1	No 2	DK 9
q98	If a person is seen going into a VCT centre do people assume he/she is infected?	Yes 1	No 2	DK 9

Knowledge about ART

q99	Is anyone you know taking drugs for HIV infection?	Yes 1	No 2	DK 9
q100	Are drugs for HIV infection available at the following places?	Ask about each one		
q100a	Village dispensary	Yes 1	No 2	DK 9
q100b	Kisesa Health Centre	Yes 1	No 2	DK 9
q100c	Magu district hospital	Yes 1	No 2	DK 9
q100d	Sekou Toure regional hospital	Yes 1	No 2	DK 9
q100e	Bugando referral hospital	Yes 1	No 2	DK 9

q101	Are the following statements about drugs for HIV treatment true or false	Ask about each one		
q101a	Drugs can only slow down HIV illness, not stop it	True 1	False 2	DK 9
q101b	ART drugs are very dangerous and can kill people	True 1	False 2	DK 9
q101c	ART drugs have to be used for life	True 1	False 2	DK 9
q101d	ART drugs are available free of charge in Tanzania	True 1	False 2	DK 9
q101e	Everyone who is infected with HIV needs drugs	True 1	False 2	DK 9

Use of health services

q102	In the last 12 months, how many times have you used the following services	write number for each, 00 if none
q102a	Hospital in patient	___ times
q102b	Hospital clinic outpatient	___ times
q102c	Health centre / dispensary	___ times
q102d	ANC or MCH or vaccination clinic	___ times
q102e	Visit from Home Based Care Worker	___ times
q102f	Private pharmacy	___ times
q102g	Traditional healer	___ times

If zero for each of q102a to q102g → q107

q103	Did you have expenses when you used these services?	Yes 1	No 2	no → q87
q104	What kind of expenses have you had? Do not read out list, but after each response ask if there were others	Write 1 for those mentioned first, 2 for the second, etc. When respondent runs out of answers write 0 in all unused lines		
q104a	Paid for meals / bed in hospital	___		
q104b	Paid for transport	___		
q104c	Paid to see doctor / nurse	___		
q104d	Paid for drugs	___		
q104e	Gave gifts to service provider	___		
q104f	Gave gifts to helper	___		

q105	Did you get help from anyone with these expenses?	Yes 1	No 2	no → q107
q106	What kind of help did you get? <i>Do not read out list, but after each response ask if there were others</i>	Write 1 for help mentioned first, 2 for the second, etc. When respondent runs out of answers write 0 in all unused lines		
q106a	Family and friends helped	<input type="text"/>		
q106b	I got a loan	<input type="text"/>		
q106c	The service provider lowered the cost	<input type="text"/>		
q106d	TUMAINI / TAZAMA / TANESA helped	<input type="text"/>		
q106e	I got district health insurance	<input type="text"/>		
q106f	Other (specify below)	<input type="text"/>		
q106g		.....	

Home based care

q107	Have you ever heard of home based care for people who are too sick to leave home?	Yes 1	No 2	No → end interview
q108	Has your village ever had home based care workers / volunteers?	Yes 1	No 2	DK 9
q109	Who organised this service? <i>Do not read out list, but after each response ask if there were others</i>	Write 1 for organiser mentioned first, 2 for second, etc. When respondent runs out of answers write 0 in all unused lines		
q109a	TUNAJALI / TUMAINI	<input type="text"/>		
q109b	TAZAMA / TANESA / NIMR	<input type="text"/>		
q109c	HUPEMEF	<input type="text"/>		
q109d	Other (specify below)	<input type="text"/>		
q109e		.....	
q110	Do people welcome home based care workers to visit them in their house?	Yes 1	No 2	DK 9
q111	Do home based care workers help with household tasks?	Yes 1	No 2	DK 9
q112	Do home based care workers provide medicines?	Yes 1	No 2	DK 9
q113	Do home based care workers give advice about going to clinics and hospitals?	Yes 1	No 2	DK 9

THANK PARTICIPANT FOR THEIR TIME AND PATIENCE

notes about interview

11.2.3 TAZAMA WI-HTC (VCT) clinic main registration book

B I N D I N G



Kisesa Health Centre VCT Log

Print Date: 2011-12-06
Version: 1.000

VCT-VCTLog-V1

rNo	VCT No		Date (DD-MM-YY)	Date last Seen (Fill in for revisits, MM-YY)	First name	Middle name	Last name	Other name	Age	Sex	Ward	Village	Sub village	Ten cell leader	Mar Status (code)	Education (code)	Religion (code)	Counseled (code)	Came from where (code)	Reason for Visit (code)	No. partners	Times Visited Kisesa VCT	Co given	Remarks	Entered	rNo
	New VCT No. for new clients	Write old VCT No if revisit										(Use Tazama Village codes where possible. See code sheet on back of cover)														
1	0																								1	
2	1																								2	
3	2																								3	
4	3																								4	
5	4																								5	
6	5																								6	
7	6																								7	
8	7																								8	
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15	14																								15	

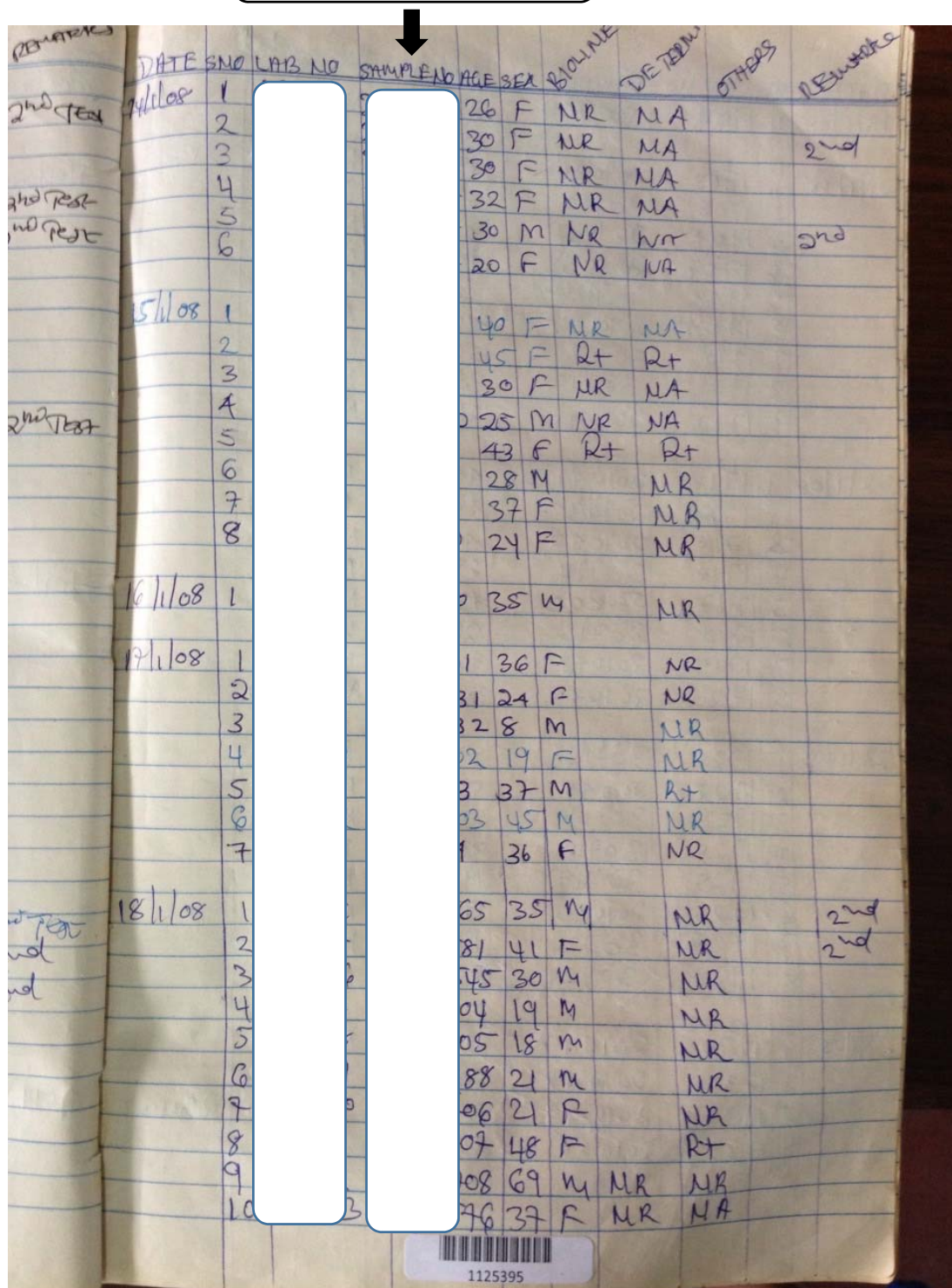
Sex Codes:	Marital Status Codes:	Occupation Codes:	Education	Religions	Counseled	Came from where	Reason for Visit:
1 Male	1 Single	1 Farmer	1 None	1 Muslim	1 Single	1 Walk-in	1 To know sero status
2 Female	2 Married - monogamous	2 Trader	2 Primary 1-4	2 Roman Catholic	2 Couple	2 ANC	2 Feeling unwell or recent illness
	3 Married - polygamous	3 Professional	3 Primary 5-7	3 Other Established Christian	3 With family member	3 Kisesa OPD	3 Pre-marriage
	4 Separated	4 Driver	4 Secondary +	4 Other Evangelical Christian	4 With supporter/care giver	4 TB clinic	4 Worried but well
	5 Divorced	5 Skilled manual worker		5 Traditional	5 Other	5 Sero Survey	5 Partner/child ill
	6 Widowed	6 Unskilled labourer		6 Other		6 Other health facility	6 Supportive counseling
		7 Fishing		7 None		7 Other	7 Other services
		8 Bar Work				8	8 Advised/referred by HCW
		9 Other					9 Retest

11.2.4 TAZAMA WI-HTC (VCT) clinic client ID card

<div>Client ID Number</div> <div></div>	<div>Appointment Dates:</div> <table><tr><td>D</td><td>D</td><td>M</td><td>M</td><td>Y</td><td>Y</td><td>Y</td><td>Y</td></tr><tr><td>D</td><td>D</td><td>M</td><td>M</td><td>Y</td><td>Y</td><td>Y</td><td>Y</td></tr><tr><td>D</td><td>D</td><td>M</td><td>M</td><td>Y</td><td>Y</td><td>Y</td><td>Y</td></tr><tr><td>D</td><td>D</td><td>M</td><td>M</td><td>Y</td><td>Y</td><td>Y</td><td>Y</td></tr></table>	D	D	M	M	Y	Y	Y	Y	D	D	M	M	Y	Y	Y	Y	D	D	M	M	Y	Y	Y	Y	D	D	M	M	Y	Y	Y	Y
D	D	M	M	Y	Y	Y	Y																										
D	D	M	M	Y	Y	Y	Y																										
D	D	M	M	Y	Y	Y	Y																										
D	D	M	M	Y	Y	Y	Y																										

11.2.5 TAZAMA WI-HTC (VCT) clinic test results book

Sample number is the field which provides the link between the main registration and test results data



DATE	SNO	LAB NO	SAMPLE NO	AGE	SEX	BLOODLINE	DETECTION	OTHERS	REMARKS
4/1/08	1			26	F	NR	NA		
	2			30	F	NR	NA		
	3			30	F	NR	NA		2nd
	4			32	F	NR	NA		
	5			30	M	NR	NR		
	6			20	F	NR	NR		2nd
5/1/08	1			40	F	NR	NA		
	2			45	F	Rt	Rt		
	3			30	F	NR	NA		
	4			25	M	NR	NA		
	5			43	F	Rt	Rt		
	6			28	M		NR		
	7			37	F		NR		
	8			24	F		NR		
16/1/08	1			35	M		NR		
17/1/08	1			36	F		NR		
	2			31	24	F	NR		
	3			32	8	M	NR		
	4			2	19	F	NR		
	5			3	37	M	Rt		
	6			33	45	M	NR		
	7			1	36	F	NR		
18/1/08	1			65	35	M	NR		2nd
	2			81	41	F	NR		2nd
	3			45	30	M	NR		
	4			04	19	M	NR		
	5			05	18	M	NR		
	6			88	21	M	NR		
	7			06	21	F	NR		
	8			07	48	F	Rt		
	9			08	69	M	NR	NR	
	10			76	37	F	NR	NA	

11.2.6 Protocol for PLA activities

HIV Testing and Counselling Study Participatory Learning and Action (PLA) Activities

Materials required: flipchart paper, masking tape, marker pens, note-books & pens, digital camera (to take pictures of flipcharts), digital recorder & spare batteries

Welcome participants as they arrive. You can greet them in Sukuma, but please inform them that we will need to do the focus group in Swahili, as this subject is difficult to discuss in Sukuma

Once everyone has arrived, ask people to take a seat

Once people have sat down, thank and welcome them again

Informed Consent and Introductions (20 minutes)
--

Introduce yourself and the note taker.

Give participants a brief overview of the study:

- Free HIV testing and counselling (HTC) services are offered at the Voluntary testing and counselling (VCT) clinic at Kisesa health centre, and also during the sero-survey rounds that are conducted in Kisesa ward every 2-3 years.
- The National Institute for Medical Research (NIMR) is carrying out a study about the HIV testing and counselling services in Kisesa.
- This information can be used to make recommendations about how these services could be improved in the future.
- We would like to know the views of men and women in this community about HIV testing and counselling services.
- We will do our best, but we cannot guarantee that we will be able to provide all the needs or suggestions that are identified by study participants today.

Explain to participants the details of how the session will be conducted:

- Today we will be having discussions and conducting activities together as a group. The activity will last about 2 hours.
- The purpose of the activities will be to *exchange* information. We will ask you to share knowledge and views of HIV testing and counselling services, and will try to answer any questions you have.
- We will be discussing together as a *group*, learning about HTC **in general**, and discussing possible ways to improve these services. No one needs to share any personal experiences of VCT or discuss sensitive topics, as this is a general discussion.
- Each person should now pick a name that they will use for the activity, to protect their identity. Real names should not be used.

- The discussion will be kept confidential by the researchers. Codes, for example “female aged 25-30”, will be used for identification in any documents or reports, so we will not record your names anywhere. All the professionals involved in this project have been trained and are committed to keeping the information confidential.
- At the end of the activities, we would like to take photos of the drawings and diagrams we have made, if everybody agrees to this. We do not wish to take photos of any people.
- It is possible that the discussion might bring up issues that are difficult or upsetting. Any participant is free to leave at any time or to not participate in any part of the activity.

If you have any questions, please feel free to ask me now and I'll try to clarify the information for you.

Does anyone have any questions?

If you have additional questions regarding the study after the discussion, you can speak with me or one of the HTC counsellors, or the fieldworker in your village that can get in touch with one of the researchers at NIMR Mwanza.

Verbal Consent

Ask participants to introduce themselves to the group using their made up names, not their real names. Explain to participants that you would like to record the discussions. Ask each participant in turn whether they agree to recording of the discussions:

Do you agree to the activities and discussions being recorded? (Answer Yes or No)

If participants do not consent to recording:

- Researchers will explore, in a sensitive way, reasons for non-consent, and will re-emphasise that all information will be kept confidential. No names will be recorded or used in any quotes in documents, publications or reports.
- Discuss the purpose of the activity – the activity does not aim to collect personal/sensitive information, just to understand people's views about the HTC services provided in this community
- Tell the group that anyone who does not want to participate can leave at any time

If all participants do not agree to recording, notes will be taken instead.

If all participants agree to recording, turn on the tape recorder and READ ALOUD:

"In this group activity we would like to discuss your views of HIV testing and counselling services. Some of the discussions may bring up issues that are difficult or upsetting, but you do not have to participate in any parts of the activity that you do not want to, and you are free to leave the discussion at any time. In reports or other documents, we may use quotes of things you say during the discussions, but these will always be anonymous (e.g. "female aged 25-30", no names will be used).

Ask each participant in turn, using their made-up name:

"[Name], do you confirm you have understood all of the information that I have given you, and agree to continue with this activity? (Yes/No).

Verbal consent only for group activities.

Consent noted for each participant by note-taker if session is not tape-recorded.

Before the session starts ensure everyone is comfortable and can see and hear each other.

Activity: Knowledge and Perceptions of HTC services

- **Brainstorming**
- **Discussing problems and possible solutions**

Explain to participants that we would like to get their general views about HIV testing and counselling services – what they know about HTC services, what they think about HTC services, what they have heard about HTC.

On a piece of flipchart paper, draw a symbol representing a HTC/VCT clinic in the middle of the page (e.g. picture of clinic building).

Prompt the discussions using the questions below. Remember, discussion is good, do not try and cut it short! Probe participants, and ask them to explain what they mean if it is not clear. As participants mention or discuss different issues, try to draw a picture representing this issue on the flipchart paper. If you cannot think of a picture to draw, write words instead.

As you go through the questions, participants may discuss different problems relating to HTC (eg they might say something like “There is no HTC clinic near to my house” or “counsellors are bad people”. Or anything similar like this). ***If problems like these come up, try to probe other participants what they think about this problem, and/or if there are any solutions or ways of overcoming this problem. If participants are confused or mention something which is incorrect, try to provide correct information to the group in a sensitive way.***

If the participants are quiet about some of the questions, you may decide to divide them up into smaller groups, to discuss each issue. Then they can report back to you. Go around to each group as they are discussing, to prompt the discussions or see if they need any help.

- ***What do you think or what do you know about HIV testing and counselling services (In general – e.g. what happens there?)***
- ***If someone wanted to go for HTC in Kisesa, where would they get this from?***
- ***Do they give information there? What kind of information do they give? Does this differ by anything (e.g. whether you are a woman or whether you are a woman, or HIV status?)***
- ***What do you think are some of the advantages of going for HTC?***
- ***What do you think are some of the disadvantages of going for HTC?***
- ***What do you think about HTC counsellors?***
- ***Is it useful to go for HTC more than once, or not?***
- ***Is there anything else about HTC that you would like to tell us?***

At the end of the discussions, when the participants have no more points to add, ***summarise the main points about HTC that were discussed today.*** Go around

the picture and address each point in turn, explaining whether the information they have heard is true or false (or partly true!) and giving more details. It is important to do this in a sensitive way – so that you leave the group with accurate information, but do not make anyone feel bad for having given a false piece of information.

Ask the participants if they have any questions for you.

Ask the participants if they consent to taking photos of the flipchart paper.

Tell the group that you will now speak to each of them in private, in order to pay them some compensation for their time and to offer the opportunity to answer any personal questions that they may have.

For each participant, the facilitator will then:

- Pay the participant compensation for their time
- Ask if there are any questions the participant would like to ask
- ***If the participant is a seed (check participant list), tell the participant that we are also interested in conducting in-depth interviews with people who have used HIV testing and counselling services before, to get their views on these services.***
ASK THE PARTICIPANT IF HE/SHE IS WILLING TO DISCUSS WHETHER HE/SHE HAS BEEN FOR HTC BEFORE.

If the participant says yes, ask if he/she would like to participate in an IDI about use of HTC services.

If the participant agrees to an IDI, agree a time and place to do the interview

11.2.7 IDI discussion guide with users of HTC services

HIV Testing and Counselling Study

In-depth interviews with users of HIV testing and counselling services

Information and Informed Consent

Thank the participant for his/her time and introduce yourself. Give participants a brief overview of the study:

- The National Institute for Medical Research (NIMR) is carrying out a study about the HIV testing and counselling services in Kisesa, to explore clients' experiences of using these services.
- NIMR can use this information to make recommendations about how the services could be improved in the future.
- We will do our best, but we cannot guarantee that we will be able to implement all the needs or suggestions that are identified by study participants.

Mention the following:

- I would like to talk to you today about your views of HIV testing and counselling services.
- The interview will take about 1-2 hours and NIMR will compensate you for the travel costs to the interview location today.
- The information you give will be kept completely confidential. Codes for example "female aged 25-30" will be used for identification in documents or reports, so we will not record your name anywhere.
- All the professionals involved have been trained and are fully committed to keeping your information confidential. However, we would like to record the discussion to help with our documentation. Only researchers at NIMR will hear this recording. However, if you do not wish to be recorded, I will take written notes during the interview instead.
- During the discussion, I will ask you for some personal information about your experiences of going for HIV testing and counselling. Some of the questions may bring up issues or emotions that are upsetting or difficult for you, but I will try to offer support and answer your questions. You do not have to answer any questions that you do not want to, and you can ask to stop the interview at any time.
- If you have additional questions regarding the study after the interview, you can speak with me or visit an HTC counsellor, or get in touch with the Director of the Tazama Project at NIMR Mwanza, Mr Mark Urassa, Tel 028-2500399.

If you have any questions about the study, please feel free to ask me now.

Signed/Witnessed Consent

I will now ask you some questions to confirm that you have understood all of the information that I have given to you, and that you agree to participate in this study:

1. Do you confirm that you have understood all of the information that I have given to you, and that you have had time to consider this information, as well as participating in the study?

Yes ☐ No ☐

2. Do you understand that your participation is voluntary, that you are free to withdraw from the study at any time, without giving any reason, and without your rights (e.g. medical, access to clinic or treatment) being affected?

Yes ☐ No ☐

3. Do you agree to this interview being recorded?

Yes ☐ No ☐

4. Do you agree to anonymous quotes of what you say being used in reports or publications?

Yes ☐ No ☐

Name of participant
witness)

Date

Signature (Or interviewer signature as

Name of interviewer

Date

Signature

Start of Interview

Turn digital recorder on.

Ice-breaker, personal details, knowledge about HIV

1. Please can you tell me a bit about you and your household? (eg Where do you live? Who do you live with? What is your relationship to them? Do you have any children? What is your level of schooling? What type of housing do you live in? What facilities do you have (electricity, water)?)
2. Can you describe to me what you do during a typical day (what type of activities), or what you do for income?
3. Do you have any partner(s)?
 - a. How long have you had your partner? Can you tell me about your relationship with this partner?
 - b. If married: can you tell me about your relationship history/previous partners?
If not married: can you tell me about any other partners that you have – who are they, how long have you had these other partners, etc?
4. Can you tell me what you know about HIV/AIDS? (How is it spread, how can it be prevented, etc?)
5. Do you fear that your partner(s) might be at risk of getting HIV or could have HIV?

HIV testing and counselling

When we met after the group activity, you told me you had used HTC services before. Now I would like to talk to you about your experience when you used that service.

6. Can you tell me about your **most recent visit** for HIV testing and counselling:
 - a. How long ago did you go for HTC?
 - b. Where did you go for testing that day (e.g Kisesa health centre – at the VCT clinic or the ANC clinic (if female)? Or elsewhere – eg Bugando, Secou Toure, somewhere else? Why did you go to this place?
 - c. Why did you go for testing? (e.g. because felt ill, was worried, planning to get married or to have a baby, etc?)
 - d. Did anyone go with you? If yes, who went with you? Why did you go with this person?
 - e. If you went on your own can you tell me why?
7. Can you tell me about what happened when you arrived at the HTC clinic?
 - a. Did you have to wait before seeing the counsellor?
 - b. If yes, how did you feel or what did you think while you were waiting to see the counsellor?

The next question is a key question, so try to probe about the relationship between the counsellor and the participant:

8. Can you tell me about the counsellor?
 - a. How did you find the HTC counsellor (eg his/her attitude or behaviour?)
 - b. What was the relationship between you and the counsellor like – did you feel comfortable with him/her?
 - c. How long did the counselling and testing take? How did you feel about the time taken?

Experience at HTC and how counselling advice was understood

These are key questions, so try to probe about what the client discussed with the counsellor. What did he/she say to the counsellor - what personal information did he/she share with the counsellor? What information did the counsellor give to the client in return? Was there a specific risk reduction plan for that client, based on what he/she said to the counsellor?

9. Did you receive pre-test counselling? Can you tell me what you said to the counsellor during pre-test counselling? **Do you feel free to share personal information with counsellors?** For example, did you tell the counsellor about your personal details - about how many partners you have, about your sexual practices with these partners (e.g. whether you use condoms or not, etc), or about any difficulties you may have with your partners? What did the counsellor say back to you, when you told him/her these things? Can you tell me if he/she gave you any information that was **specific to you and your life**? What information did he/she give to you? **Was it a two-way discussion, or was the information general?**
10. Did you receive post-test counselling? What did you discuss during post-test counselling – can you tell me about what you said to the counsellor, and about what the counsellor said to you? **Was the information specific or was it general – how was it specific or how was it general?**
11. Can you tell me how you **felt** about what the counsellor said to you? **Did you feel you would be able to implement the advice that he/she gave to you? If yes – how did you implement this advice? If not, why could you not implement the advice?**
12. Can you tell me whether you think one counselling session is enough, to help you to protect yourself or your partners from HIV? Or should people go for counselling more than once? If yes, why should they go for counselling more than once? If not, why not? (*Focus should be on **counselling** as opposed to testing*).
13. Can you describe how you felt when you left the clinic, after you had been for HTC?
14. Did you decide to tell anyone you had been for HTC? If yes, who did you tell? Why did you tell this person? If not, why did you decide not to tell anyone?

15. Did you have any thoughts or feelings which were different after going for HTC, compared to before? Eg about your partner, about yourself, about your relationships? Can you tell me about these thoughts or feelings?

Other

16. Would you encourage a partner or a friend to go for HTC? Why or why not?
17. Have you been for HTC more than once? If yes, why did you to go for testing again? Or if you have been only once, why did you not return for testing?
18. If you have been for HTC more than once, was your experience different the next time you went, compared to the first time? Ie did you feel differently about attending the clinic, or about the counsellor, or about what he/she said to you?
19. What do you think are effective ways for people to protect themselves from HIV in this community – can you tell me about this? Are there additional or other things that individuals, or communities, can do to help to prevent the spread of HIV?
20. Are there any suggestions or improvements that you think could be made to HTC services?
21. Is there anything else about your experience(s) of HIV testing and counselling that you would like to share with me?

End of interview. Thank the participant for his/her time and contributions, and pay the compensation.

11.2.8 IDI discussion guide with VCT counsellors

IDIs with VCT Counsellors

Information Sheet

The National Institute for Medical Research (NIMR) is doing a research study to explore the provision of HIV testing and counselling (HTC) services in Kisesa, and how clients perceive the counselling advice that they receive. It is important to do this as HTC services expand and as the number of clients attending for testing increases.

We are interested in:

- Understanding the messages and information that are shared with clients during HTC, and whether you feel clients understand these messages and/or find them useful or helpful.
- Learning how counselling messages are adapted for different clients, according to their individual circumstances or needs.
- Understanding what training is provided for counsellors, and if you have any ideas about how counsellor training sessions could be improved.
- Learning about any re-fresher trainings or support that is provided for HTC counsellors.
- Hearing any ideas you may have about possible improvements to the design and delivery of HTC services in Kisesa and in Tanzania.

Although we will try our best, we cannot guarantee that we will be able to incorporate all the suggestions you make during the study.

If you have any questions about the information that I've given you, or about the study, please feel free to ask, and I'll do my best to answer.

If you have further questions about the study after this conversation, you can contact Mark Urassa (director of the TAZAMA study) at NIMR Mwanza.

Consent Form

Thank you very much for taking the time to meet with me today. This interview will take about 1.5 hours and will be kept completely confidential. We will be using anonymous codes to identify participants - your name will be recorded on this form only for the purpose of obtaining informed consent. All the professionals involved in the project have been trained and are fully committed to keeping information confidential.

We will be producing a report in order to communicate the findings of this research, which we will make available once it is finished. In the report or other published documents, we may give examples of some things you say during the interview, but we will NOT include your name or any other details: instead we would write "Health Worker number 1", for example.

We would like to tape record this interview to help with our documentation. Only researchers at NIMR will hear this tape. If you do not wish to be recorded, we will take written notes during the interview instead. You do not have to answer any questions that you do not want to, and you can ask to stop the interview at any time.

Please answer yes or no to the questions below:

1. Do you confirm that you have understood all of the information that I have given to you, and that you have had time to consider this information, as well as participating in the study?

Yes ☐ No ☐

2. Do you understand that your participation is voluntary, that you are free to withdraw from the study at any time, without giving any reason?

Yes ☐ No ☐

3. Do you agree to this interview being recorded?

Yes ☐ No ☐

4. Do you agree to anonymous quotes of what you say being used in reports or publications?

Yes ☐ No ☐

Name of participant

Date

Signature

Name of Interviewer

Date

Signature

A – INTERVIEWS WITH VCT COUNSELLORS

Turn digital recorder on

Part 1 – Introduction

1. Can you tell me a bit about yourself and your profession:
 - a) How long have you been a counsellor? Have you always worked in Kisesa, or have you also worked in other places? If so, where? How did your work in other places compare to your work in Kisesa - was there anything that was similar or anything that was different?
 - b) Can you describe a typical day to me, e.g.:
How many clients do you usually see in one day?

How long does each counselling session normally take?

Can you tell me about any positive aspects or things that you enjoy in your day-to-day work?

Can you tell me about any challenges or things that are difficult in your day-to-day work?

Part 2 – Experiences as a counsellor

2. Can you tell me what you normally discuss with a client during a pre-test counselling session? How long does a pre-test counselling session normally take?
3. Can you tell me about the testing process – how do you explain this to clients? How long does it normally take to do the test(s)? Do clients normally wait in the room with you while you do the test, or do they wait outside?
4. Can you tell me about a typical post-test counselling session with someone who tests HIV negative? E.g. how long does the post-test counselling normally take? What are typical reactions from the client? What issues are covered? What is easy or what is difficult about counselling people who test HIV negative?
5. Can you tell me about a typical post-test counselling session with someone who tests HIV positive? E.g. how long does the post-test counselling normally take? What are typical reactions from the client? What issues are covered? What are the issues or challenges when counselling people who test HIV positive? What referrals or further information do you provide for people who test HIV positive?

6. Do you provide couple counselling services (i.e. counselling for couples who come to test together). What different issues do you cover, or what different challenges do you face, when providing counselling for couples?

7. Do you provide any other types of counselling services – E.g:
Group counselling?

Counselling for young people?

Ante-natal counselling and testing for pregnant women?

Can you tell me about anything which is different, or any of the issues, when providing counselling for these different types of clients?

Probe for issues relating to each type of counselling that the participant mentions.

8. Do you provide supportive counselling services? If yes, what sort of issues do you normally discuss with clients during supportive counselling? How long do supportive counselling sessions normally take? What are the positive aspects or the challenges of providing supportive counselling?
9. Do you provide any other types of counselling services, apart from those we have already discussed? If yes, can you tell me about these other counselling services that you provide?

Part 3 – How clients receive HTC services

The next few questions are about how clients receive HTC services.

10. How do you think HTC services are received or perceived by:
- people in the community in general?
- clients who have used the service?
11. Without mentioning any names, can you think about a time or a client for whom the VCT service seemed **helpful**? Can you describe this time or example? Why was the VCT useful or helpful for this person? How did he or she react to counselling, or to you, or to the information he/she received?
12. Without mentioning any names, can you think about a time or a client for whom VCT was **not helpful**? Can you describe this time or example? Why did the VCT not seem helpful for this person? How did he or she react to counselling, or to you, or to the information he/she received?

Part 4 – Training for counsellors

13. Can you tell me about any training that you received to become a counsellor, eg: Where did you receive training? Who conducted the training (which organisation)? How long was the training for?
14. Can you tell me broadly what topics were covered during the training – i.e. what were you taught or what did you learn and discuss?
15. Can you tell me about any counselling theories, methods or approaches that were taught during training? What do you think about these different methods or approaches? What is good or useful about them and what is bad or not useful about them? Do you tend to use similar approaches with all clients, or different methods with different clients? Can you tell me about this?
16. What do you think are skills of a good counsellor?
17. What do you think are characteristics of a poor or weak counsellor?
18. Can you tell me how you feel about the training that you received. E.g. did it meet your needs or expectations? Has it taught you the skills that you feel you need to do your job? Did it cover relevant topics? How did you feel about the length of training, or the amount of training received?
19. Can you tell me about any refresher trainings that you receive during the course of your work? E.g. who runs this training, how often is it offered or does it occur, what topics are covered in refresher training?

Part 5 – Support for counsellors and professional development

20. Do you have any other responsibilities or duties, apart from being an HTC counsellor? If yes, can you tell me about these responsibilities or duties? How do you manage your workload or balance your time to manage these different tasks?
21. Can you tell me about any professional support or supervision that you receive as a counsellor? How do you feel about the support that you receive (or about the lack of support)?
22. Is there any other training or support that you feel would help you to perform your job? If yes, can you tell me about this?

Part 6 - Other

- 23. Can you identify the biggest challenge that you face in your daily work? Can you describe this to me?
- 24. Can you identify the most satisfying or the most positive aspect of your job? Can you describe this to me?
- 25. Are there any issues that we have discussed today that you'd like to talk about further?
- 26. Do you have any questions or other comments about any of the topics that we have discussed today?

End of interview – wrap up and thank the respondent

11.2.9 IDI discussion guide with healthcare workers offering PITC

IDIs with healthcare workers involved in Provider Initiated Testing & Counselling

Information Sheet

The National Institute for Medical Research (NIMR) is doing a research study to explore the provision of HIV testing and counselling (HTC) services in Kisesa, and how clients perceive the counselling advice that they receive. It is important to do this as both Voluntary Counselling and Testing (VCT) and Provider Initiated Testing and Counselling (PITC) services expand, and the number of clients receiving these services increases.

We are interested in:

- Understanding how PITC services are provided in Kisesa, and how patients perceive or receive the service (e.g. how they understand counselling information or messages, whether they find the service useful or not, etc).
- Understanding your experiences in providing PITC, and how you balance this responsibility with other duties or tasks that you have.
- Understanding what training is provided for staff involved in PITC, and if you have any ideas about how the training could be improved.
- Learning about any re-fresher trainings or support that is provided for healthcare workers involved in PITC.
- Hearing any ideas you may have about possible improvements to the design and delivery of VCT or PITC services in Kisesa and in Tanzania.

Although we will try our best, we cannot guarantee that we will be able to incorporate all the suggestions you make during the study.

If you have any questions about the information that I've given you, or about the study, please feel free to ask, and I'll do my best to answer.

If you have further questions about the study after this conversation, you can contact Mark Urassa (director of the TAZAMA study) at NIMR Mwanza, Tel: 028-2500399.

Consent form same as for VCT Counsellors, see Appendix 11.2.8

INTERVIEWS WITH HEALTHCARE WORKERS INVOLVED IN PITC

Turn digital recorder on

Part 1 – Introduction

1. Can you tell me a bit about the ante-natal clinic (ANC):
 - What facilities are available there and what services are provided there?
 - How many staff work at the clinic? What are their different responsibilities or roles?
 - How many patients are generally seen at the clinic each day?
2. Can you tell me a bit about your job:
 - What duties or tasks are you normally involved in providing?
 - How many patients do you normally see in a typical day?

Part 2 – Experiences of PITC

3. Can you tell me about provider initiated testing and counselling (PITC) at the ANC clinic:
 - How long has this service been offered?
 - What is the uptake of PITC like – what proportion of women generally accept PITC, and how do they react to this service (e.g. are they positive or negative about it, nervous or happy, etc)?
 - How often do you refer PITC clients to the VCT clinic (e.g. because you are unable to do testing at the ANC - due to time constraints, lack of test-kits or re-agents, etc)?
4. Can you tell me about your experiences in providing PITC: how long have you been involved in providing PITC? How many PITC sessions do you normally conduct in a day? Where is the service offered (e.g. is there a separate room at the ANC where you can conduct PITC? If not where do you conduct PITC?).
5. Can you tell me about pre-test counselling in PITC – is this done in groups or individually? How long does pre-test counselling normally take? Can you tell me what you normally discuss with a patient during pre-test counselling?
6. Can you tell me about the testing process – how do you explain this to patients? How long does it normally take to do the test(s)? Do the patients wait with you in the same room while you do the tests, or do they wait somewhere else?
7. Can you tell me about post-test counselling with somebody who tests HIV negative? E.g. how long does the post-test counselling normally take? What are typical reactions from the patient? What do you normally discuss with the

patient? What is easy or what is difficult about PITC with women who test HIV negative?

8. Can you tell me about post-test counselling with somebody who tests HIV positive? E.g. how long does the post-test counselling normally take? What are typical reactions from the patient? What do you normally discuss with the patient? Do you normally provide referrals to other services for patients who test HIV positive? If yes can you tell me about these? What is easy or what is difficult about PITC with women who test HIV positive?

Part 3 – How patients receive PITC

The next few questions are about how PITC services are received or perceived by people in the community in general and by patients.

9. How do you think PITC services are received or perceived by:
 - people in the community in general?
 - women who attend the ANC clinic?
10. Without mentioning any names, can you think about a time or a patient for whom the PITC service seemed **helpful**? Can you describe this time or example? Why was the PITC useful or helpful for this person? How did the woman react to counselling, or to you, or to the information she received?
11. Without mentioning any names, can you think about a time or a client for whom PITC was **not helpful**? Can you describe this time or example? Why did the PITC not seem helpful for this person? How did the woman react to counselling, or to you, or to the information she received?

Part 4 – Training for PITC

12. Can you tell me about any training that you received for PITC. E.g: Where did you receive training? Who conducted the training (which organisation)? How long was the training for?
13. Can you tell me broadly what topics were covered during training? (E.g. Scientific information about HIV/AIDS? HIV/AIDS testing procedures? Principles or methods of counselling? Referral procedures? etc)
14. Can you tell me how you feel about the training that you received - did it meet your needs or expectations? Did it give you the skills or information you feel you need in order to provide PITC services?

15. Can you tell me about any suggestions or recommendations you may have in order to improve PITC training?

Part 5 – On-going support and professional development

16. Can you tell me about any refresher trainings that you receive in relation to PITC? (E.g. who runs the training, how often is it offered or does it occur, what topics are covered in refresher training?)
17. Can you tell me about your workload – how do you balance your other tasks and responsibilities with provision of PITC? How do you feel about your workload - what is it like - e.g. light or heavy? Manageable or not manageable?
18. Can you tell me about any professional support or supervision that you receive at work? How do you feel about the support or supervision that you receive (or about the lack of support/supervision)?
19. Is there any other training or support that you feel would help you to perform your job well? If yes, can you tell me about this?
20. Can you tell me about any positive aspects or things that you enjoy in your day to day work?
21. Can you tell me about any difficult things or challenges that you face in your day to day work?

Part 6 – Other

22. Are there any other suggestions or recommendations you have in relation to either the provision of PITC services, or to training and support for healthcare workers involved in PITC?
23. Are there any issues that we have discussed today that you'd like to talk about further?
24. Do you have any questions or other comments about any of the topics that we have discussed today?

End of interview – wrap up and thank the respondent

11.2.10 IDI discussion guide with HTC trainer

IDI with HTC Trainer

Information Sheet

The National Institute for Medical Research (NIMR) is doing a research study to explore the provision of HIV testing and counselling (HTC) services in Kisesa, and how clients perceive the counselling advice that they receive. It is important to do this as HTC services expand and as the number of clients attending for testing increases.

We are interested in:

- Understanding the messages and information that are shared with clients during HTC, and whether you feel clients understand these messages and/or find them useful or helpful.
- Learning how counselling messages are adapted for different clients, according to their individual circumstances or needs.
- Understanding what training is provided for counsellors, and if you have any ideas about how counsellor training sessions could be improved.
- Learning about any re-fresher trainings or support that is provided for HTC counsellors.
- Hearing any ideas you may have about possible improvements to the design and delivery of HTC services in Kisesa and in Tanzania.

Although we will try our best, we cannot guarantee that we will be able to incorporate all the suggestions you make during the study.

If you have any questions about the information that I've given you, or about the study, please feel free to ask, and I'll do my best to answer.

If you have further questions about the study after this conversation, you can contact Mark Urassa (director of the TAZAMA study) at NIMR Mwanza.

Consent form same as for VCT Counsellors, see Appendix 11.2.8

B – INTERVIEWS WITH TRAINERS

Turn digital recorder on

Part 1 – Introduction

Explain that we would like to know about training for HIV counsellors in Magu district (or Mwanza region, if relevant).

1. Can you tell me a bit about training for HIV counsellors in Magu district or Mwanza region:
 - Which organisation(s) are responsible for organising and running training for HIV counsellors in Magu district/Mwanza region?
 - How often is this training normally offered/run?
 - How many trainers are normally involved in each session or course (e.g. one trainer, or more than one?)
2. Can you tell me a bit about yourself and your job:
 - How long have you been involved in running training for HIV counsellors? Can you tell me about the duties and tasks that you are involved in?
 - Were you a counsellor previously? If yes can you tell me about this – e.g. how long were you a counsellor for? Where did you work? How did you find this job as a counsellor (what were the positive and negative aspects of that job?)
 - How did you start to become involved in training for counsellors? How do you find this job – what are the positive and negative aspects of being a trainer?

Part 2 – Training for new VCT counsellors

3. Can you tell me about training courses for people to become new VCT counsellors:
 - How often are training courses normally offered or run?
 - For somebody to become a new VCT counsellor, how long does the training usually take?
 - How many participants usually take part in each course?
 - How many trainers are usually involved in running each course (e.g. one? or more than one?)

4. Can you give me an overview of the curriculum, or tell me what topics are covered, in training for new VCT counsellors? (e.g. basic science? Counselling theory? Counselling for different groups or situations? Treatment and care services for HIV negative and/or HIV positive people?).
5. Can you tell me about any specific counselling theories, methods or approaches which are taught during training? If different methods or approaches are taught, how are counsellors taught to adapt these, depending on the needs of individual clients?
6. Can you tell me your thoughts about training for new VCT counsellors? E.g. does the curriculum meet the needs of VCT counsellors, in order to allow them to do their job well? Are there any changes or recommendations you would suggest to improve the training for VCT counsellors?
7. What are the challenges when providing training for new VCT counsellors?
8. What are the positive aspects of providing training for new VCT counsellors?

Part 3 – Ongoing professional development, support and refresher training for VCT counsellors

9. Are on-going or refresher trainings offered for VCT counsellors? If yes, which organisation(s) offer or run these courses? How often are they offered, or how often do VCT counsellors normally go for refresher training?
10. Can you tell me what topics are normally covered in refresher training? What are the goals of these courses, and what content or material do they include?
11. What other supervision or support is available to VCT counsellors? Who is responsible for providing this supervision or support (e.g. clinic in charge? District medical officer? Regional medical officer?)
12. Can you tell me your opinion about the refresher training or supervision and support that is available for VCT counsellors?

Part 4 – Training for PITC

13. Can you tell me about training for provider initiated testing and counselling (PITC)? Is this different to training for new VCT counsellors? Can you give me

an overview of the goals of PITC training, and what topics it covers? How long do PITC courses normally take? Which organisation(s) are responsible for running PITC courses?

14. Can you tell me about any refresher training or ongoing professional development or support that are offered for staff who provide PITC services?
15. Can you tell me your opinion about training for PITC (e.g. how well it meets the needs of health-care workers involved in providing PITC, suggestions for changes or improvements to the training provided)?

Part 5 – Other

16. What do you think are the main challenges that HIV counsellors (VCT or PITC) face in their day to day work – can you describe these to me?
17. What are the main challenges you face in your job as a trainer – can you tell me about these?
18. What are the positive aspects of your job as a trainer – can you tell me about these?
19. Do you have any suggestions as to how training for HIV counsellors could be improved in this district or region, or in Tanzania in general?
20. Are there any issues that we have discussed today that you'd like to talk about further?
21. Do you have any questions or other comments about any of the topics that we have discussed today?

11.3 Parameters for the linkage algorithm

The matching procedure used for the analyses presented in this thesis was based on version 1 of the linkage algorithm described in the following document.

TAZAMA VCT Auto-Matcher

Introduction

- 1) This is a brief description of the stored procedure that implements the matching of the VCT data to the DSS data. There are two stored procedures that implement the matching, and they differ in the way that the individual component scores are computed and combined.
- 2) Unless stated otherwise, all tables and stored procedures mentioned in this document are located in the SQL Server database KisesaVCT.

Matching Algorithms

Input Data

- 1) For both versions of the algorithm the inputs are the same and are the VCT data, and the DSS data to which it is to be matched. The DSS data is taken from AbidanceTable, augmented by the Village, Sub Village, and Ten Cell Leader names from GeoUnitsTable. The following cases are excluded from the DSS input data:
 - The geography represented by the GeoUnitID is missing or invalid
 - The first name is missing
 - The second name is missing
 - The sex is missing or invalid
- 2) The VCT data is taken from three sources:
 - The table valued function [dbo].[tfn_VCTNumberV001_00] that contains encrypted VCT data;
 - the join of the tables [dbo].[VCTIdentifiers] and [dbo].[VCTLog];
 - the table [PostedData].[dbo].[VCTLOGFE_1_01]
- 3) Where sex is missing from the VCT data it is estimated by using the gender probabilities of the names found in the table [dbo].[NameSexProb], provided that the probability found in the table exceeds 0.85.
- 4)

Output Data

- 1) Data about the matches are stored in the output table VCT_PossibleMatches by version V1 of the algorithm, and in VCT_PossibleMatches_V3 by version V3 of the algorithm. Apart from the column SourceIdentifier that occurs in the version V3 output, both tables have the same structure, given in Table 1 below. The primary key of the table is indicated by underlining the names of the columns of the key.
- 2) The column labeled 'SourceIdentifier' is obtained by concatenating the following columns of the tables used to construct the input VCT data, and separating them by semi-colons ';':
 - A constant:
 - 1 if the input was from [dbo].[tfn_VCTNumberV001_00]
 - 2 if the input was from [dbo].[VCTIdentifiers] and [dbo].[VCTLog]
 - 3 if the input was from [PostedData].[dbo].[VCTLOGFE_1_01]

- The VCT number
- If the input was from [dbo].[VCTIdentifiers] and [dbo].[VCTLog]
 - The RID of the input row from [dbo].[VCTIdentifiers]
 - The RID of the input row from [dbo].[VCTLog]
- If the input was from [PostedData].[dbo].[VCTLOGFE_1_01], the VRID of the input row.

3) The scheme such as this has turned out to be necessary due to the appearance of duplicate VCT numbers in the input data, leading to insertion failures in the output tables VCT_PossibleMatches and VCT_PossibleMatches_V3 as these originally had (VCTNumber, AbidanceID, MatchRoutine) as a multi-column primary key.

Name	Type	Description
<u>VCTNumber</u>	Int	The VCT number of the person being matched.
<u>AbidanceID</u>	Int	The Abidance ID of the person against whom the match is being made.
TotalScore	Float	The total score for the match
FirstNameRawScore	Float	The raw score of the first name match
SecondNameRawScore	Float	The raw score of the matching of the second names
GenderRawScore	Float	The raw gender matching score
AgeRawScore	Float	The raw age matching score
VillageRawScore	Float	The raw village name matching score
SubVillageRawScore	Float	The raw subvillage name matching score
TenCellLeaderRawScore	Float	The raw ten cell leader matching score
FirstNameScore	Float	The final first name matching score
SecondNameScore	Float	The final second name matching score
GenderScore	Float	The final gender matching score
AgeScore	Float	The final age matching score
VillageScore	Float	The final village name matching score
SubVillageScore	Float	The final sub village name matching score
TenCellLeaderScore	Float	The final ten cell leader name matching score
VCTFirstNameFreq	Float	The relative frequency of the first name in the VCT data
VCTLastNameFreq	Float	The relative frequency of the last name in the VCT data
VCTFullNameFreq	Float	The relative frequency of the full name (first name followed by last name) in the VCT data.
DSSFirstNameFreq	Float	The relative frequency of the first name in the DSS data
DSSLastNameFreq	Float	The relative frequency of the last name in the DSS

Name	Type	Description
		data
DSSFullNameFreq	Float	The relative frequency of the full name (first name followed by last name) in the DSS data
<u>MatchRoutine</u>	Text	The name given to the parameter set that was used in the run of the algorithm
Verified	Int	Always zero. Used by other routines.
<u>SourceIdentifier</u>	Text	An identifier used to distinguish between input rows that have the same VCTNumber

Table 1: Output Table Columns

Method

- 1) The present implementation of the matching algorithm is based on the following variables taken from the VCT data (the *source*) variables: first name, second name, gender, year of birth, village name, subvillage name, and ten-cell leader name, and a similar set of variables taken from the DSS data (the *target*): first name, second name, gender, year of birth, village name, sub-village name, and ten-cell leader name. For each pair of variables, one from the source and the other being the corresponding variable from the target, a score is computed and these are then summed to give a total score for the pair of records. A match is declared if the total score exceeds a pre-set threshold, which is passed as an input parameter to the routine. When a match is declared information about the match is written to the output table.
- 2) In addition to the total score exceeding the threshold, constraints have been placed on some of the individual scores and these must also be satisfied before the source and target are declared to be matched.
- 3) The similarity $\text{Sim}(\text{Name1}, \text{Name2})$ between two names, Name1 and Name2 is given by the function

$$1 - \text{Levenstein}(\text{Name1}, \text{Name2}) / \text{Max}(\text{length}(\text{Name1}), \text{length}(\text{Name2}))$$

where:

Levenstein(Name1, Name2) is the Levenstein distance between Name1 and Name2. The Levenstein distance between two words is the minimum number of single-character edits (insertion, deletion, substitution) required to change one word into the other

This similarity function lies in the range 0 to 1 inclusive, is 0 if the names are totally dissimilar and 1 if the names are identical.

First Name Score

Raw Score

- 1) This is the similarity of the first name of the source and the first name of the target:
 $\text{Sim}(\text{VCT First Name}, \text{DSS First Name}),$

Final Score – Version 1

- 1) This is a cubic polynomial in the raw first name score, R:

$$(a_{13} * R^3 + a_{12} * R^2 + a_{11} * R + a_{10}) * w_1$$

where a_{10} , a_{11} , a_{12} , a_{13} , and w_1 are constants whose values are given in the appendix.

Final Score – Version 3

- 1) This is given by the non-linear function:

$$\lfloor R/c_1 \rfloor * g_1 + f_1$$

where R is the raw score, c_1 (the cutoff), g_1 (the gap), and f_1 (the offset) are constants whose values are given in the appendix.

- 2) The effect of the floor function, $\lfloor \rfloor$ is to turn the final score, as a function of the raw score R, into a series of discrete steps with a constant value between each step.

Second Name Score

Raw Score

- 1) This is the maximum of the similarities of the second name of the source and the first and second names of the target:

$$\text{Max}(\text{Sim}(\text{VCT Second Name}, \text{DSS First Name}), \text{Sim}(\text{VCT Second Name}, \text{DSS Second Name}))$$

- 2) The constraint on the second name score is that it must exceed 0.6

Final Score – Version 1

- 1) This is a cubic polynomial in the raw second name score, R:

$$(a_{23} * R^3 + a_{22} * R^2 + a_{21} * R + a_{20}) * w_2$$

where a_{20} , a_{21} , a_{22} , a_{23} and w_2 are constants whose values are given in the appendix.

Final Score – Version 3

- 1) This is given by the non-linear function:

$$\lfloor R/c_2 \rfloor * g_2 + f_2$$

where R is the raw score, c_2 (the cutoff), g_2 (the gap), and f_2 (the offset) are constants whose values are given in the appendix.

- 2) The effect of the floor function, $\lfloor \rfloor$ is to turn the final score, as a function of the raw score R, into a series of discrete steps with a constant value between each step.s

Gender Score

Raw Score – Version 1

- 1) This is given by the formula:
 - 5 if DSS Gender = VCT Gender
 - -5 otherwise.

Final Score – Version 1

- 1) This is simply the weighted value of the raw score:

$$R * w_{13}$$
 where w_{13} is the gender weight whose value is given in the appendix.

Raw Score – Version 3

- 1) This is given by the formula:
 - 1 if DSS Gender = VCT Gender
 - 0 otherwise

Final Score – Version 3

- 1) This is given by the formula:
 - $5 * w_{23}$ if DSS Gender = VCT Gender
 - $-5 * w_{23}$ otherwise
 where w_{23} is the gender weight whose value is given in the appendix

Year of Birth Score

Raw Score

- 1) The year of birth raw score is given by the absolute value of the difference between the two ages:

$$|VCT \text{ Year of Birth} - DSS \text{ Year of Birth}|$$
- 2) The constraint on Year of Birth is that the source and target must not differ by more than 10 years, i.e.

$$|VCT \text{ Year of Birth} - DSS \text{ Year of Birth}| \leq 10$$

Final Score – Version 1

- 1) This is given by the formula:

$$(-e^{R * b_{11}} + b_{12}) * b_{13}$$

where R is the Year of Birth raw score, and b_{11} , b_{12} , and b_{13} are constants whose

values are given in the appendix.

Final Score – Version 3

- 1) This is given by the formula:

$$(-R^{b_{21}} * b_{22} + b_{23}) * b_{24}$$

where R is the Year of Birth score, and b_{21} , b_{22} , b_{23} , and b_{24} are constants whose values are given in the appendix.

Village Score

Raw Score

- 1) The village raw score is the similarity between the VCT village name and the DSS village name:
Sim(VCT Village Name, DSS Village Name).
- 2) There are no additional constraints on the village raw score.

Final Score – Version 1

- 1) This is simply the weighted village raw score

$$R * v_1$$

where R is the raw village score and v_1 (the village weight) is a constant whose value is given in the appendix.

Final Score – Version 3

- 1) This is given by the non-linear function:

$$\lfloor R/c_3 \rfloor * g_3 + f_3$$

where R is the village raw score, and c_3 (the cutoff), g_3 (the gap), and f_3 (the offset) are constants whose values are given in the appendix.

- 1) The effect of the floor function, $\lfloor \rfloor$ is to turn the final score, as a function of the village raw score R, into a series of discrete steps with a constant value between each step.

Subvillage Score

Raw Score

- 1) The subvillage raw score is the similarity between the VCT subvillage name and the DSS subvillage name:
Sim(VCT Subvillage Name, DSS Subvillage Name).
- 2) There are no additional constraints on the subvillage raw score.

Final Score – Version 1

- 1) This is simply the weighted subvillage raw score

$$R * v_2$$

where R is the raw subvillage score and v_2 (the subvillage weight) is a constant whose value is given in the appendix.

Final Score – Version 3

- 1) This is given by the non-linear function:

$$\lfloor R/c_4 \rfloor * g_4 + f_4$$

where R is the subvillage raw score, and c_4 (the cutoff), g_4 (the gap), and f_4 (the offset) are constants whose values are given in the appendix.

- 2) The effect of the floor function, $\lfloor \rfloor$ is to turn the final score, as a function of the subvillage raw score R, into a series of discrete steps with a constant value between each step.

Ten-Cell Leader Score

Raw Score

- 1) The ten-cell leader raw score is the similarity between the VCT ten-cell leader name and the DSS ten-cell leader name:
 $\text{Sim}(\text{VCT Ten-cell Leader Name}, \text{DSS Ten-cell Leader Name})$.
- 2) There are no additional constraints on the ten-cell leader raw score.

Final Score – Version 1

- 1) This is simply the weighted ten-cell leader raw score

$$R * v_3$$

where R is the raw ten-cell leader score and v_3 (the ten-cell leader weight) is a constant whose value is given in the appendix.

Final Score – Version 3

- 1) This is simply the weighted ten-cell leader raw score

$$R * v_4$$

where R is the raw ten-cell leader score and v_4 (the ten-cell leader weight) is a constant whose value is given in the appendix.

Appendix

Values of the Constants

Version 1

	Parameter Name	Value	Notes
a_{10}	Name0Order1	-3	First Name Parameters
a_{11}	Name1Order1	-0.6	
a_{12}	Name2Order1	4.0	
a_{13}	Name3Order1	8.0	
w_1	FirstNameWt	3.217200725477540000E+119	
a_{20}	Name0Order2	-3	Second Name Parameters
a_{21}	Name0Order2	-0.6	
a_{22}	Name0Order2	4.0	
a_{23}	Name0Order2	8.0	
w_2	SecondNameWt	1.785129198009530000E+119	
w_{13}	GenderWt	2.11E+118	Gender Parameter
b_{11}	Age3rdExponent	0.6	Year of Birth Parameter
b_{12}		1.28402541669000	
b_{13}	AgeWt	1.524010308350720000E+116	
v_1	VillageWt	0	Village Parameter
v_2	SubVillageWt	3.34E+119	Subvillage Parameter
v_3	TenCellLeaderWt	0	TenCell Parameter

Version 3

	Parameter Name	Value	Notes
c ₁	NameCutOff1	0.6	First Name Parameters
g ₁	NameGap1	100	
f ₁	NameOffset1	40	
c ₂	NameCutOff2	0.6	Second Name Parameters
g ₂	NameGap2	60	
f ₂	NameOffset2	10	
w ₂₃	GenderWt	1	Gender Parameter
b ₂₁	AgePower	5	Year of Birth Parameters
b ₂₂	AgeCurve	0.1	
b ₂₃	AgeOffset	250	
b ₂₄	AgeWt	1	
c ₃	VillageCutOff2	0.6	Village Parameters
g ₃	VillageGap2	60	
f ₃	VillageOffset2	15	
c ₄	SubVillageCutOff2	0.6	Subvillage Parameters
g ₄	SubVillageGap2	60	
f ₄	SubVillageOffset2	15	
v ₄	TenCellLeaderWt	0	TenCell Parameter

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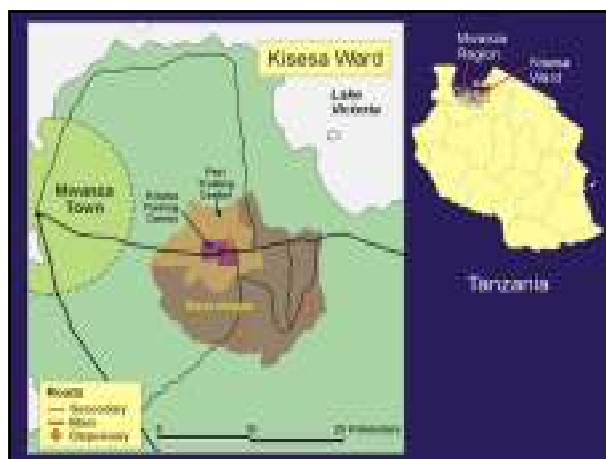
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11.5 Conference presentations and posters

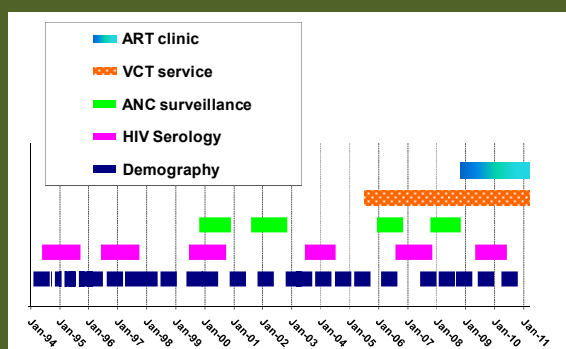
11.5.1 ICASA 2011 presentation slides

Socio-demographic and clinical factors associated with repeat HIV counseling and testing in a community cohort study in Tanzania

Caoimhe Cawley, Alison Wringe, Mark Urassa, Raphael Isingo, Jim Todd, Yusufu Kumogola, Rose Manyalla, Benjamin Clark, John Chagalucha, Basia Zaba



Timing of Kisesa study activities



Methods

- Analyses included those who attended both Sero 4 (2003-4) and Sero 5 (2006-7), and who used the VCT service at both rounds
- Statistical methods: logistic regression

Numbers attending and using VCT at Sero 4 and Sero 5, by sex

	Number Attending			Number using VCT (%)		
	M	F	Total	M	F	Total
Sero 4	3951	5012	8963	480 (12.2)	370 (7.4)	850 (9.5)
Sero 5	3612	5051	8663	663 (18.4)	777 (15.4)	1440 (16.6)
Sero 4 AND Sero 5	1562	2271	3833	89 (5.7)	64 (2.8)	153 (4.0)

Socio-demographic factors associated with repeat use of VCT among individuals who were HIV negative at Sero 4

Variable ^a	N = 3701		
	N (% Repeat Testing)	Crude OR (95% CI)	Adjusted OR (95% CI)
Sex			
Male	1503 (5.5)	1	1
Female	2198 (2.9)	0.5 (0.4-0.7)***	0.7 (0.5-1.0)*
Age			
≥45	1331 (2.9)	1	
15-24	802 (1.9)	0.6 (0.4-1.1)	
25-34	874 (5.4)	1.9 (1.2-2.9)**	
35-44	694 (6.3)	2.2 (1.4-3.5)***	
Area of residence			
Rural	2077 (3.8)	1	
Roadside	961 (5.0)	1.3 (0.9-1.9)	
Trading centre	663 (2.9)	0.8 (0.4-1.3)	
Education			
None	1382 (1.4)	1	1
Primary 1-4 yrs	391 (3.6)	2.5 (1.3-5.0)**	1.8 (0.9-3.7)
Primary 5-7 yrs	1623 (6.0)	4.3 (2.7-7.0)***	3.2 (1.9-5.3)***
Secondary +	303 (4.6)	3.3 (1.6-6.6)***	2.4 (1.2-4.9)*

^a As recorded at Sero5
*p<0.05, **p<0.01, ***p<0.001

Association between marital status change and repeat use of VCT among men

Marital status Sero 4 - Sero 5	Males (N=1503)		
	N (% Repeat Testing)	Crude OR (95% CI)	Adjusted OR (95% CI) [†]
Married monog-married monog	710 (5.6)	1	1
Never married-Never married	346 (1.4)	0.2 (0.1-0.6)**	0.2 (0.1-0.6)**
Married polyg-married polyg	30 (10.0)	1.9 (0.5-6.4)	2.1 (0.6-7.6)
Widowed/separated-Widowed/separated	40 (7.5)	1.4 (0.4-4.6)	2.1 (0.6-7.4)
Not married-married	153 (10.5)	2.0 (1.1-3.6)*	1.9 (1.0-3.5)*
Married monog-married polyg	41 (14.6)	2.9 (1.1-7.2)*	2.5 (0.9-6.9)
Married polyg-married monog	32 (12.5)	2.4 (0.8-7.1)	2.2 (0.7-6.8)
Married-Widowed/Separated	36 (13.9)	2.7 (1.0-7.3)*	3.5 (1.2-10.1)*
Never married-Widowed/separated	19 (0)	-	-

[†] Adjusted for sex and education
*p<0.05, **p<0.01, ***p<0.001

Association between marital status change and repeat use of VCT among women

Marital status Sero 4 - Sero 5	Females (N=2198)		
	N (% Repeat Testing)	Crude OR (95% CI)	Adjusted OR (95% CI) [†]
Married monog-married monog	967 (2.9)	1	1
Never married-Never married	97 (3.1)	1.1 (0.3-3.6)	0.9 (0.3-3.2)
Married polyg-married polyg	140 (2.9)	1.0 (0.3-2.8)	1.1 (0.4-3.1)
Widowed/separated-Widowed/separated	396 (1.3)	0.4 (0.2-1.1)	1.1 (0.4-3.2)
Not married-married	196 (2.0)	0.7 (0.2-2.0)	0.7 (0.2-2.0)
Married monog-married polyg	116 (6.9)	2.5 (1.1-5.6)*	2.5 (1.1-5.7)*
Married polyg-married monog	75 (2.7)	0.9 (0.2-3.9)	1.1 (0.2-4.8)
Married-Widowed/Separated	141 (2.8)	1.0 (0.3-2.8)	1.6 (0.5-5.0)
Never married-Widowed/separated	23 (17.4)	7.1 (2.2-22.1)**	8.0 (2.4-26.3)***

[†] Adjusted for sex and education
*p<0.05, **p<0.01, ***p<0.001

Association between HIV status at Sero 4 and Sero 5 and repeat use of VCT

	Males (n=1554)		Females (n=2255)	
	N (% Repeat Testing)	Crude OR (95% CI)	N (% Repeat Testing)	Crude OR (95% CI)
Negative, negative	1462 (5.3)	1	2127 (3.0)	1
Negative, positive	37 (10.8)	2.18 (0.75-6.31)	57 (0)	-
Positive, positive	55 (12.7)	2.62 (1.15-5.99)*	71 (1.4)	0.47 (0.06-3.42)

Discussion

- Uptake of VCT and rates of repeat testing low overall (data are from 2003/4 and 2006/7)
- Repeat uptake of VCT lower among women and those with least education
- No association between sero-conversion and likelihood of repeat testing

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- London School of Hygiene and Tropical Medicine

11.5.2 ICASA 2011 poster presentation

The role of Voluntary Counselling and Testing in HIV prevention and sexual behaviour change



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Background

- Voluntary counselling and testing (VCT) advocated as gateway for access to treatment and care, but also as means to promote primary prevention of HIV
- Recent studies indicate impact of VCT on reductions in sexual risk behaviour unclear, particularly among HIV negative individuals
- Aim: to investigate the impact of VCT on sexual behaviour change across two rounds of serological surveillance, using data from an open HIV cohort study

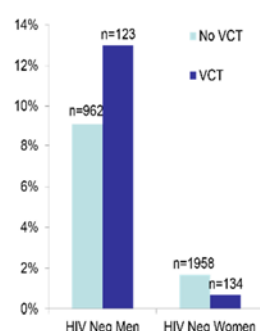
Methods

- Kisesa cohort study: serological surveys of adults aged ≥15 every 2-3 years
- Anonymous HIV testing plus questionnaire on sexual behaviour, health service use and HIV-related knowledge & attitudes
- Routine offer of VCT at sero-survey rounds in 2003-4 (Sero 4) & 2006-7 (Sero 5)
- Logistic regression used to investigate impact of attending VCT at Sero 4 on changes in sexual behaviour at Sero 5 (number of sexual partners in last month & year, sex with high risk partners, condom use at last sex), by HIV status & sex

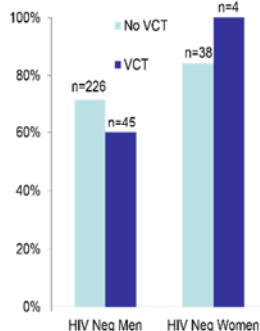
Results

- 3,955 individuals attended both sero-surveys (1,630 men, 2,325 women), with 331 (8.4%) completing VCT at the earlier round (182 men, 149 women)
- Among HIV positive individuals, not possible to test many of the associations between VCT at Sero 4 and outcomes at Sero 5, due to small sample sizes
- Among HIV negative individuals, few associations between VCT at Sero 4 and outcomes at Sero 5 statistically significant – proportions reporting changes in behaviour similar regardless of VCT attendance

0/1 sexual partner in last month at Sero 4 – proportion increasing to 2+ partners at Sero 5, by VCT use



2+ sexual partners in last month at Sero 4 – proportion decreasing to 0/1 partner at Sero 5, by VCT use



Results (continued)

- However, HIV negative women using VCT at Sero 4 more likely to report using a condom at last sex with spouse at Sero 5
- Weak evidence that HIV negative women using VCT at Sero 4 also more likely to report using condoms with other partner types at Sero 5

Logistic regression for change in condom use behaviour, HIV negative women

Used condom at last sex with spouse? (Y/N)		Adjusted Odds Ratio*	p Value
No at Sero 4, Yes at Sero 5	No VCT	1	0.02
	VCT	4.69 (1.22-18.0)	
Yes at Sero 4, No at Sero 5		Too few data	
Used condom at last sex – any partner? (Y/N)		Adjusted Odds Ratio*	p Value
No at Sero 4, Yes at Sero 5	No VCT	1	0.11
	VCT	2.19 (0.83-5.77)	
Yes at Sero 5, No at Sero 5	No VCT	1	0.11
	VCT	0.12 (0.01-1.65)	

*Adjusted for age and marital status at Sero 5

Discussion

- The overall uptake of VCT at Sero 4 was low (11.2% of men who attended both sero-surveys, 6.4% of women who attended both sero-surveys)
- Little evidence of impact of VCT on sexual behaviour change among HIV negative individuals. However, could misclassification be present - individuals not using VCT at Sero 4 may have used testing services elsewhere in the inter sero-survey period?
- Investigation of the impacts of VCT among HIV positive individuals was limited by small sample sizes
- The uptake of VCT has increased in Kisesa in recent years – data from more recent sero-surveys may allow for a more rigorous investigation of the impacts of VCT on sexual behaviour change among HIV negative and positive individuals

11.5.3 HIV/AIDS Interdisciplinary Perspectives conference presentation slides

Access to HIV counselling and testing services in rural Tanzania

Caoimhe Cawley, Alison Wringe, Jim Todd, Annabelle Gourlay, Benjamin Clark, Clemens Masesa, Richard Machemba, Georges Reniers, Mark Urassa, Basia Zaba



Overview

- Background
- Study site and methods
- Results
- Conclusions

HIV in Tanzania

- Estimated 1.4 million people living with HIV in 2013 (range 1.3-1.5 million)
- Prevalence of 5.0% (range 4.6%-5.3%) in adults aged 15-49
- Estimated 72,000 adults and children newly infected in 2013 (range 59,000-87,000)

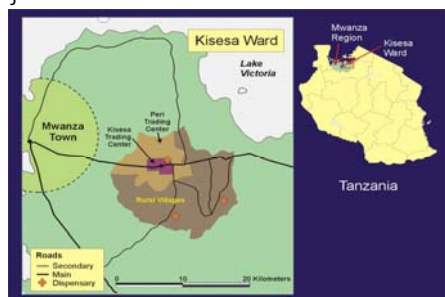
*Source: UNAIDS. <http://www.unaids.org/en/dataanalysis/>

HIV counselling and testing services

- Voluntary counselling and testing (VCT) - traditional model
- Provider initiated testing and counselling (PITC)
- Home based testing
- Outreach/mobile testing
- Self-testing

TAZAMA Project

- Demographic surveillance site
- HIV serological surveillance
- Kisesa Health Centre



Study objective

- Identify factors associated with VCT use during Sero6 or at Kisesa Health Centre

Data sources:

- Outreach VCT service provided during Sero6 in 2010
- Permanent VCT clinic at the health centre (client visits between 2010-2012) – linked to cohort dataset

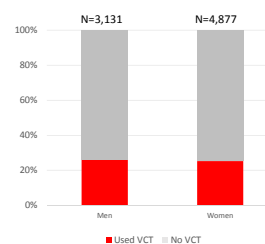
Statistical analyses:

- Logistic regression models (Stata v12)

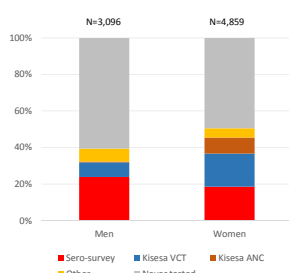
VCT at Kisesa Health Centre

- Linkage rate for clinic records was low (17.8%)
- Case-control analysis among Sero6 participants with a link to the permanent VCT clinic (fewer numbers than analysis of VCT use at sero-survey)
- However positive predictive value was reasonable (69%)

VCT at Sero6



Location of first test by sex, all Sero6 attendees



Age: older men and women had lower odds of testing

Year of birth	Men				Women			
	VCT Sero6	VCT Health Centre	VCT Sero6	VCT Health Centre	VCT Sero6	VCT Health Centre	VCT Sero6	VCT Health Centre
	N (% using VCT)	aOR (95% CI)	N (% using VCT)	aOR (95% CI)	N (% using VCT)	aOR (95% CI)	N (% using VCT)	aOR (95% CI)
1986-1995	1,494 (19.7)	1	167 (16.8)	1	1,689 (23.3)	1	78 (37.2)	1
1976-1985	458 (37.6)	1.14 (0.84,1.54)	43 (23.3)	0.55 (0.19,1.56)	1,132 (32.6)	0.98 (0.79,1.22)	58 (58.6)	1.74 (0.62,4.86)
1966-1975	417 (35.7)	1.14 (0.83,1.58)	60 (35.0)	1.00 (0.40,2.49)	819 (31.3)	0.96 (0.76,1.23)	52 (55.8)	2.25 (0.77,6.56)
1956-1965	313 (32.6)	1.03 (0.73,1.47)	48 (12.5)	0.31 (0.10,1.00)	516 (26.7)	0.88 (0.66,1.19)	59 (23.7)	0.8 (0.26,2.47)
1905-1955	447 (21.3)	0.67 (0.48,0.94)	182 (5.5)	0.24 (0.10,0.58)	720 (9.9)	0.34 (0.23,0.50)	255 (2.4)	0.41 (0.11,1.57)

aOR = adjusted odds ratio
95% CI = 95% confidence interval

Area: those living in roadside villages or trading centre had higher odds of testing

Area of residence	Men				Women			
	VCT Sero6	VCT Health Centre	VCT Sero6	VCT Health Centre	VCT Sero6	VCT Health Centre	VCT Sero6	VCT Health Centre
	N (% using VCT)	aOR (95% CI)	N (% using VCT)	aOR (95% CI)	N (% using VCT)	aOR (95% CI)	N (% using VCT)	aOR (95% CI)
Rural	1,772 (15.8)	1	278 (11.2)	1	2,493 (14.0)	1	258 (20.2)	*
Roadside	763 (36.3)	2.61 (2.09,3.26)	124 (20.2)	2.11 (1.09,4.10)	1,284 (34.7)	2.97 (2.48,3.56)	129 (27.1)	*
Trading centre	596 (42.8)	3.43 (2.72,4.33)	98 (19.4)	1.30 (0.63,2.68)	1,100 (39.5)	3.83 (3.16,4.64)	115 (21.7)	*

aOR = adjusted odds ratio
95% CI = 95% confidence interval
*Not significant for inclusion in multivariable model

HIV positive individuals had higher odds of using VCT at health centre

HIV Status	Men		Women	
	N (% using VCT)	aOR (95% CI)	N (% using VCT)	aOR (95% CI)
Negative	472 (14.2)	1	474 (20.5)	1
Positive <3 years	3 (0)	*	6 (16.7)	0.4 (0.03,5.20)
Positive ≥3 years	20 (35.0)	4.52 (1.36,15.03)	21 (66.7)	10.7 (2.53,44.97)

aOR = adjusted odds ratio
95% CI = 95% confidence interval
*Too few data to calculate OR

HIV status and VCT use during Sero6

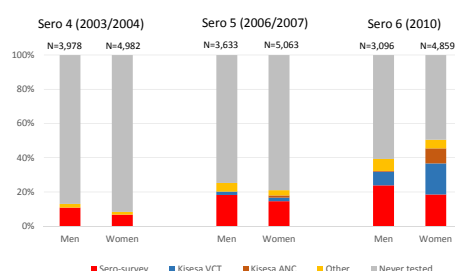
- Men HIV positive ≥ 3 years had higher odds of using VCT if they had never used any HCT before, **OR 1.96** (1.15-3.32)
- But not if they had used HCT before, **OR 0.57** (0.32-1.00)
- Women HIV positive ≥ 3 years had lower odds of using VCT if they had used any HCT before, **OR 0.38** (0.26-0.57).

Those with more sexual partners had higher odds of testing

	Men				Women			
	VCT Sero6		VCT Health Centre		VCT Sero6		VCT Health Centre	
Number of sex partners	N (% using VCT)	aOR (95% CI)	N (% using VCT)	aOR (95% CI)	N (% using VCT)	aOR (95% CI)	N (% using VCT)	aOR (95% CI)
None	322 (21.1)	0.65 (0.46,0.91)	59 (10.2)	1.25 (0.43,3.61)	858 (16.6)	1.06 (0.73,1.54)	225 (1.8)	0.03 (0.00,0.20)
One	1,315 (31.6)	1	247 (11.7)	1	3,261 (30.1)	1	231 (40.7)	1
Two or more	640 (36.2)	1.12 (0.89,1.42)	91 (31.9)	2.92 (1.45,5.87)	100 (44.0)	1.84 (1.16,2.90)	4 (50.0)	0.2 (0.01,4.15)

aOR = adjusted odds ratio
95% CI = 95% confidence interval

Location of first test, trends over time



Conclusions

- By 2010, still only 50% of women and 40% of men who had ever tested (low considering this is a high prevalence area)
- Different VCT services attracted different individuals – women more likely to use clinic compared to men. Clinic more 'selective' (measures of effect stronger), VCT during sero-survey more 'inclusive'
- Both services attracted those with higher risk sexual behaviours and HIV-positive individuals.
- However, for treatment as prevention to be effective, services need to reach as many people as possible. Important underserved groups include men and those living in rural areas

Policy implications

- Decentralisation of services may help to increase rates of testing in rural areas
- Different models of delivery help to make services more equitable
- Need to understand which testing services are most effective at linking positive individuals to treatment and care

Acknowledgements

- Participants of Kisesa cohort study
- VCT counsellors and other field staff
- Colleagues at NIMR, Mwanza
- Colleagues at LSHTM

11.5.4 IAS 2015 Abstract (upcoming poster presentation)

Title: 'It is just the way it was in the past before I went to test'. Exploring the role of HIV prevention counselling in sexual behaviour change in rural Tanzania

Authors: Caoimhe Cawley, Alison Wringe, Shelley Lees, Joyce Wamoyi, Mark Urassa

Track C: Prevention Science (C50 – HIV testing)

Background: HIV counselling in the context of undergoing an HIV test is assumed to play an important role in preventing new infections by encouraging clients to develop and apply individualised risk-reduction plans. However, few qualitative studies have explored the processes through which clients in sub-Saharan Africa might modify their behaviour. We conducted a qualitative study to explore HIV-negative and HIV-positive individuals' attitudes towards this advice and their perceived ability to implement it following HIV testing in rural Tanzania.

Methods: Nine sex-specific participatory group activities gathered community perceptions of HIV testing and counselling (HTC). Thirty in-depth interviews (IDIs) with HIV-negative and HIV-positive service users explored individual experiences of HTC including testing motivations, the client-counsellor relationship, and attitudes towards advice on sexual risk reduction. Five IDIs were conducted with HTC providers to understand their perspectives. Study activities were conducted in KiSwahili, recorded and transcribed, and then translated into English. Nvivo10 was used for coding and analysis of transcripts, guided by a framework approach.

Results: We identified several individual-level, related attributes including skills, perceived self-efficacy, attitudes and intentions which influenced how counselling messages were interpreted and acted upon (Figure 1). However, individual level attributes were strongly mediated by socio-cultural norms such as expectations of multiple partnerships, a perceived inability for women to communicate about safer sex with partners, or beliefs that condoms were associated with promiscuous behaviour. Advice was often referred to as 'instructions' systematically covering 'ABC' prevention messages, reflecting imbalanced client-counsellor power relations, with little tailoring to clients' circumstances. Clients' perceived abilities to act upon counselling advice was also constrained by environmental factors such as poverty and economic dependency.

Conclusions: HIV prevention counselling is unlikely to significantly contribute to sexual behaviour change unless counselling messages are generated through a truly open client-provider discussion. Counselling messages should also be tailored to individual circumstances, taking account of users' existing skills, attitudes and intentions towards risk reduction and acknowledging prevailing socio-cultural norms and environmental constraints.

Figure 1: Conceptual framework for understanding responses to HIV prevention counselling in rural Tanzania

